

California Integrated Waste  
Management Board

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Contractor's Report

To The Board



## Improving Used Oil Recycling in California

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Lawrence Livermore National Laboratory

California Environmental Protection Agency

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# Executive Summary

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Optimizing the reuse of California's waste is an important goal toward improving the sustainability and reducing the environmental impact of our growing society's needs. The California Integrated Waste Management Board (CIWMB) commissioned staff at Lawrence Livermore National Laboratory (LLNL) to provide an independent assessment of the current state of California's used oil recycling market and to provide recommendations that facilitate the recycling of used oil to its "highest and best use." "Highest and best use" was defined as "recycling into base lube oil" since it has both the characteristics of lowest environmental impact and highest sustainability. The report integrates market analysis, environmental assessment, regulatory reporting documents, numerous stakeholder interviews, and feasibility evaluations in order to form a set of recommendations for making improvements toward this goal.

California's current used oil market does not maximize the supply of, or demand for, used oil being recycled back to American Petroleum Institute (API) certified lube oil. State incentives for certified used oil collection centers have successfully improved the amount of used oil collected, but significant amounts remain uncollected and the current incentive has no impact on how the used oil is recycled.

While concerns about prevention of environmental contamination are paramount, designating used oil as a hazardous waste increases the cost and limits the range of viable approaches for responsible recycling.

Optimization of the used oil system requires taking steps that maintain open market efficiencies using incentives to move the market toward CIWMB goals. Optimization also requires maximizing the quantity of used oil available for recycling to base lube oil and the willingness to utilize markets and facilities outside of California to meet the needs and goals of the State.

Our recommendations are intended to facilitate the recycling of used oil back into base lube oil primarily through market-driven forces. This approach minimizes the amount of government regulation and oversight, while maintaining California's leadership in environmental responsibility and stewardship. We have five recommendations that address system limitations documented in the report for different aspects of the current oil recycling market. The report provides a detailed rationale for each recommendation.

## **Our recommendations:**

- Increase the fee on lube oil sales based on the increased financial needs for future success and implementation of CIWMB goals.
- Implement effective "green" education promoting recycled API-certified lube oil.
- Encourage and support increased curbside used oil collection.
- Provide a monetary incentive, based on the volume of API-certified base lube oil produced from used oil collected in California, to recycling facilities producing API-certified base lube oil both within and outside California, provided the facility maintains California standards for used oil handling, waste classification, and disposal.
- Reduce all or part of the fee on lube oil sales based on the percent of API-certified recycled content. In other words, the greater the percentage of API-certified recycled content, the lower the fee.

Although outside of this report's tasking, one important note about these recommendations is that not all used oil can be recycled to base lube oil and, for this fraction, we recommend that production of other recycled products with a low environmental impact should be encouraged. For used oil not recycled to API-certified base lube oil, the production of industrial lube oil or marine distillate oil (MDO) is a preferred alternative, in terms of environmental impact, to recycled fuel oil (RFO) which does not undergo distillation. Therefore, an additional recommendation is to provide a smaller monetary incentive, relative to the base lube production incentive, to facilities that produce industrial lubricant or MDO from California's used oil, provided they adhere to California's testing and waste management procedures.

# Introduction

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## ***Project History***

CIWMB has long recognized that much of the used oil collected in California is processed into fuel oil instead of being re-refined back into lubricating oils. In search of potential ways to increase re-refining, as through utilization of the large oil refining capacity within the State, CIWMB solicited scientists from Lawrence Livermore National Laboratory (LLNL) to assess the potential for blending used lubricating oil into crude oil destined for an oil refinery. Lawrence Livermore staff with a strong background in petroleum chemistry and engineering were originally tasked with evaluating the technical feasibility and regulatory limitations of blending used oil into crude.

A key assumption for pursuing this evaluation was that the only re-refiner in the State, Evergreen Oil, Inc., did not have the capacity to re-refine all the used oil collected in California. However, during initial interviews with interested stakeholders, we learned that this primary assumption was not completely valid. Although Evergreen Oil does not currently have the capacity to re-refine all of California's used oil, Gary Colbert, Vice President of Operations for Evergreen Oil, indicated that capacity was not the limiting factor for his operations (Gary Colbert, personal communication, February 7, 2007). Evergreen had won approval to renovate its plant to nearly triple the operating capacity, and the company's concern was whether or not there would be a large enough supply of used oil feedstock to operate at the expanded capacity. He indicated that he was working on legislation to require a mandatory re-refined content for all oil sold within California.

After this disclosure, LLNL and CIWMB met to discuss how to modify LLNL's research. During this meeting, all parties agreed that the term "recycling," has been applied to various products that do not meet the same reuse characteristics. In California, only "re-refining" used oil into a base stock for new lubricant products represents "closed-loop" recycling, whereas the production of various fuel oils is more accurately described by the term "single-use recycling" or "downcycling\*." It was further agreed that, for oil that has the potential to be recycled to base lube oil, "single-use recycling" and "downcycling" do not meet the standard for "highest and best use" set by CIWMB. This evaluation criterion for recycled products has drawn criticism from recyclers that produce "single-use" recycled products with a low environmental impact. Our analysis of environmental impact included contaminants released, energy conservation, and resource sustainability. This analysis confirmed recycling to base lube oil as the "highest and best use."

## ***Objectives***

Although the scope of this evaluation was modified during the course of the project, CIWMB's goal for the effort had not changed. CIWMB's goal has always been to increase the amount of used oil being recycled back into lubricating oil, and to increase the analytical efforts for identifying feasible approaches. Specifically, LLNL's objective was to characterize California's current used oil recycling market and to assess what potential policy implementations could promote an increase in closed-loop recycling.

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\* The phrases "closed-loop recycling," "single-use recycling," and "downcycling" are defined below.

The original scope of work included a brief market analysis based on the belief that existing infrastructure could be used to increase closed-loop recycling. When this was deemed infeasible, CIWMB redirected LLNL to complete a more thorough analysis of the used oil market and examine how the current incentive program affects the end-use outcome. Specific objective-based tasks included:

1. Review the current used oil market scenario in terms of volumes sold, collected, treated, and re-sold in various product forms.
2. Provide a technical review of the various oil recycling processes and evaluate their compliance with CIWMB's "highest and best use" criteria, including their environmental impacts.
3. Identify several possibilities for changing California's current incentive program for used motor oil to promote closed-loop recycling and evaluate potential market responses to such a change.
4. Provide recommendations for institutional and policy changes that will optimize the "highest and best use" of used motor oil.

## **Definitions**

Numerous terms used throughout this report may be new to some readers, although most are industry-standard terms. Please refer to the glossary for definitions.

Several terms do need to be clarified since they are not industry standard and understanding the difference is critical to understanding this assessment. For the purposes of this report the expressions "closed-loop recycling," "single-use recycling," and "downcycling" are defined as,

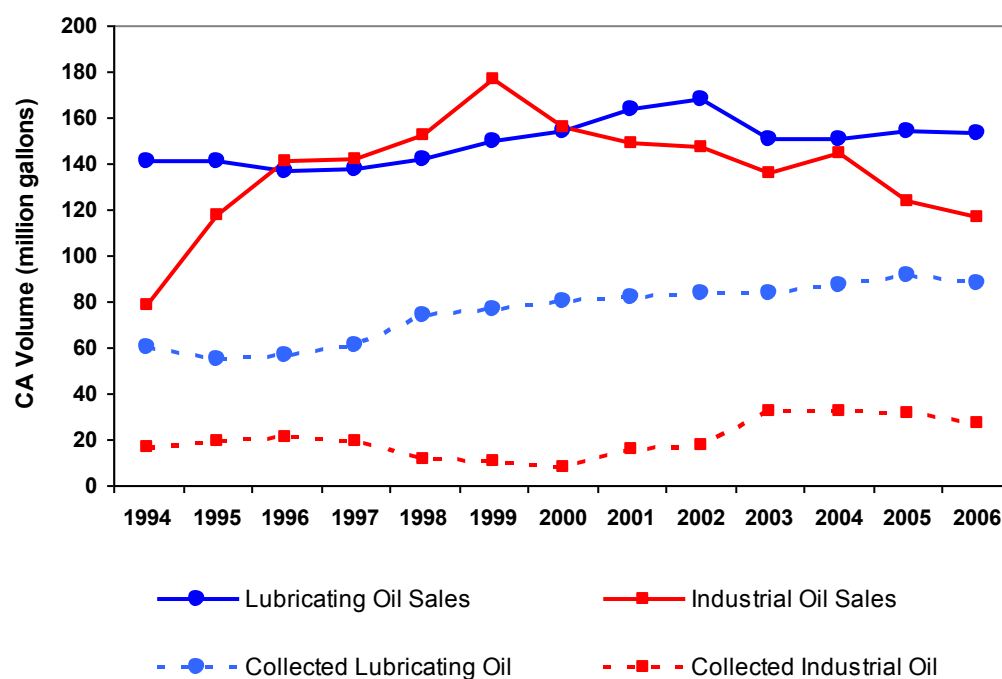
- Closed-loop recycling: Process where the quality of the recycled product equals or exceeds the quality of the original material and can itself be recycled through the same processes in a repeatable cycle.
- Single-use Recycling: Process where the recycled product cannot be recycled again and thus has a single finite reuse.
- Downcycling: Process where the quality of the recycled product is less than the quality of the original material.

It is important to note that even closed-loop recycling for used oil is not 100 percent closed-loop in terms of oil recovery. Also, not all used oil is of sufficient quality to be recycled in an economically feasible way through closed-loop processes, or even single-use and downcycling processes. These characterizations of recycling processes and products, although generalized, provide useful metrics for understanding fundamental differences among various recycled products.

# Used Oil Market

## Used Oil Collection Efficiency

In 1979, the responsibility to oversee used oil collection and recycling was assigned to the California Waste Management Board (CWMB, 1985). Since then, volumes of oil sold and collected have been recorded and are categorized within two broad groups: Lubricating oils for the transportation sector or Industrial oils. Sales and collection trends for both categories from 1994-2006 are shown in Figure 1.



**Figure 1. Oil sales and used oil collection trends, 1994-2006. Data from CIWMB (2006 and 2007).<sup>†</sup>**

Figure 1 shows that for volumes of oil sold, except for the year 1999, lubricating oils for the transportation sector have accounted for 46-64 percent of the total oil sales within California. In 1995, lubricating oil sales for the transportation sector accounted for ~55 percent, which is similar

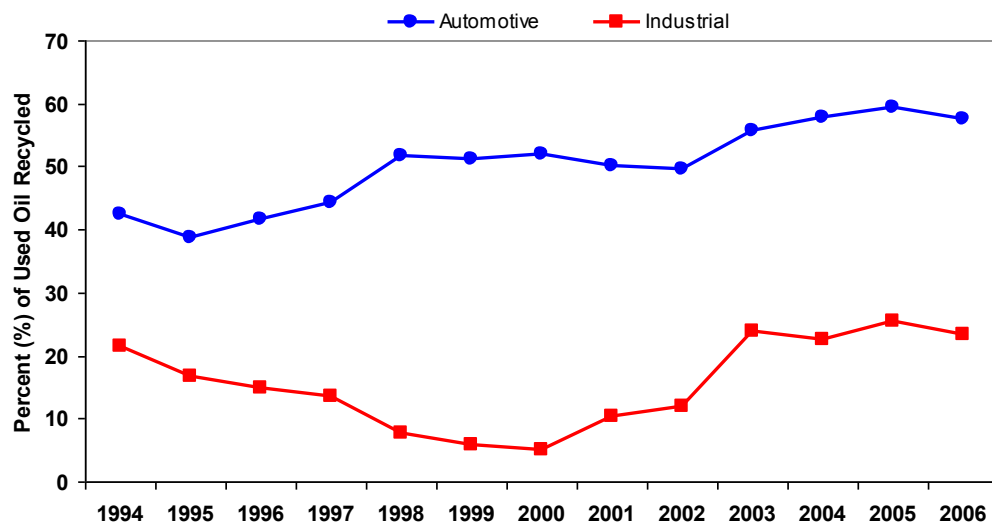
<sup>†</sup> According to Bob Boughton (DTSC), the increase in industrial volumes collected (and therefore the percent collected as presented Figure 2) is an artifact of a change in the information collection and data reduction methodologies for 2003 compared to previous years: Recent estimates do not remove volumes of water collected with the industrial oils.

to, albeit slightly lower than, the national estimate accounting for ~60 percent of oil sales for the same year (Department of Energy (DOE), 2006).

Although the national volume estimates are not shown here, it is interesting to note that California lubricating oil sales for the transportation sector represent ~10 percent of the total national automotive lubricants demand. California industrial oil sales account for an even higher percentage of the total volume sold nationwide: ~27 percent of the industrial oils sold in the United States are sold in California.

More pertinent are the estimates of volumes collected. It is clear from Figure 1 that the absolute amount of used oil collected has increased from 1994 to 2006. In fact, since 1983 when the Department of Toxic Substances Control (DTSC) started collecting a registration fee from haulers, the volumes of collected used oil reported to the state have increased from 37.9 Mgal to 115.3 Mgal in 2006 (CWMB, 1985; CIWMB, 2007).

Of course, the volumes of oil sales have also increased during that time period. The fact that the *percentage* of used oil collected has generally increased over a similar period illustrates the effectiveness of the State's Used Oil Program. Figure 2 shows the steadily increasing trend in collection efficiency for automotive oil since 1994 and for industrial oil since 2000. The percentages were determined by calculating the amount of used oil collected relative to the amount sold<sup>‡</sup>. This increase in collection efficiency (by ~20 percent in the automotive sector) is likely due to CIWMB's emphasis on establishing a used oil collection system as part of the CORE Act of 1992 (see Appendix A) (Cal Poly San Luis Obispo, 2005).



<sup>‡</sup> The values for collection efficiency were obtained by comparing the volumes collected to the volumes sold for each year. Because some oil is lost during engine operation, a more accurate estimation of collection efficiency would account for this missing volume since what is lost by definition can not be collected; however, estimates of the amount of oil lost during consumption are not available for most years.

**Figure 2. Percentage of oil sales collected as used oil. Estimates do not account for oil lost during engine operation. Data from CIWMB (2006 and 2007).**

## Used Oil Sources

Figure 2 shows an overall trend of increasing collection efficiency in both sectors of the oil market. Note that the collection efficiency for automotive oils is significantly greater than for industrial oils. This can partially be explained by the nature of the two different oil streams.

### Automotive Oils

Automotive lubricants are generally considered to be of higher quality than industrial oils for recycling to base lube oil. These oils must meet higher certification standards because the operating environment for motor oils is more severe than the operating environment in most industrial settings. For instance, motor oils must remain within specification at much higher operating temperatures, and thus over a larger temperature range relative to industrial oils. Furthermore, automotive oils have a greater likelihood of exposure to gases, water, and soot.

Despite this harsh operating environment, collected used motor oils are generally relatively clean. Any heavy metal contaminants present in automotive oils primarily come from the additives used to enhance their lubricating ability. Additives are complex, oil-soluble molecules that can serve several functions, and typically account for ~12-15 wt. percent of the finished lubricant product. Each additive is a potential source of various heavy metals and other contaminants commonly detected in used oil. Table 1 provides a matrix of several contaminants and their common additive source.

**Table 1: Common Contaminants in Used Automotive Oils and Their Additive Sources**

	(ppm)	Grease	Anti-oxidant <sup>1</sup>	Detergent <sup>1</sup>	Dispersant <sup>1</sup>	Anti-wear <sup>1</sup>	VI / Friction <sup>1</sup>	AR/AC <sup>1</sup>	High P <sup>2</sup>	External <sup>3</sup>
<b>Al</b>	5-30	x								x
<b>B</b>	75-100		x		x	x	x		x	x
<b>Ca</b>	2,000-3,000	x	x	x						x
<b>Cl</b>	300-600					x			x	
<b>Cu</b>	25-40		x			x				x
<b>Mg</b>	100-300			x						x
<b>N</b>	700-900		x		x					
<b>Na</b>	50-100	x						x		x
<b>P</b>	800-1200		x			x		x		x
<b>Pb</b>	50	x							x	x
<b>S (%)</b>	0.7-0.9		x	x		x			x	
<b>Si</b>	30-120									x
<b>Zn</b>	1,000-1,200		x			x		x		
<b>Mo</b>	5-20					x			x	

Data adapted from Table 2.5 in Audibert (2006)

<sup>1</sup> For a listing of the chemical components in these additives, the reader is directed to Table 9 in DOE (2006). Additional information can also be found beginning on Page 10 in Audibert (2006).

<sup>2</sup> "High P" refers to extreme-pressure lubricants. These products may use different additives than standard engine additives but are still a potential source of various contaminants.

<sup>3</sup> “External” sources of contaminants are unrelated to the presence of additives and commonly include wear and corrosion of engine parts, atmospheric dust, and circuit water for cooling.

## **Industrial Oils**

According to Section 48616 of the Public Resources Code, industrial oils may include hydraulic fluids, metal-working fluids, general utility greases, and transformer oils. Relative to automotive engines, these uses generally allow lower grade oils for operation. As a function of how these oils are utilized and combined, used industrial oils may have higher concentrations of heavy metal contaminants, solvents, and particulate matter and, as a result, are more variable in quality.

Used industrial oils also have the potential to be closed-loop recycled; however, if they contain higher heavy metal and sediment concentrations, they require greater amounts of energy input for removal. Thus, re-refining used industrial oils is technically possible but can be economically disadvantageous<sup>§</sup>.

## **Importance of Segregated Source Streams at Used Oil Generators**

Because these two different oil sources are often used at disparate locations, the collections of the two used oil streams are sometimes separated, until picked up by a hauler. Maintaining the segregation of these used oil streams can be important depending on the recycling facility receiving the oil because cleaner used oil is easier to recycle back to the original product quality. When used oil generators combine high-quality and low-quality used oils, the potential exists to reduce the viability for closed-loop recycling the entire volume of used oil.

## **Source Segregation During Transport**

While used automotive and industrial oils can be generated by the same user, a large volume of automotive oil is generated and collected at locations that only handle automotive oil. Many of the haulers who transport used oil voluntarily keep used automotive and industrial oils segregated by having dedicated compartments on a single tanker truck. Because haulers are paid for their used oil partly based on the quality of the product, this voluntary segregation allows the haulers to efficiently service various facilities within a geographic area on a single run while maintaining the quality of the used lubricating oil. If the generators maintained source segregation, but the haulers mixed the industrial and automotive oils, they could have a more difficult time selling the oil to a used oil re-refining facility.

## **Source Segregation at Recycling Facility**

Despite the fact that industrial and automotive oils are generally segregated based on generator, and that segregation is generally maintained by the hauler, the two streams are sometimes mixed upon receipt at a recycling facility. At facilities that do not receive large quantities of industrial oil, the amount mixed with the automotive may be insufficient to degrade the quality of the overall oil product. However, at facilities that receive large volumes of industrial oils, the resultant mixed oil would reduce the viability for closed-loop recycling into API-certified lube oil, although production of other recycled products is still possible.

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<sup>§</sup> Closed-loop recycling of industrial oils is not done in California; the processes are similar to those described on Page 10 to produce MDO.

## **Recycled Oil Products**

In California, used oil is considered a hazardous waste whether it is used automotive oil or used industrial oil. In order for it to be recycled and sold back to consumers it must be de-classified as a hazardous waste, which can only occur at a state-certified recycling facility.

As previously mentioned, the term “recycled oil” has been broadly applied to include closed-loop, single-use and downcycled products. According to paragraph (3) of subdivision (a) of Section 25250.1 of the Health and Safety Code, “recycled oil” is any oil produced from used oil that has been produced by an in-state generator lawfully recycling its oil, by an in-state certified recycling facility, or by an out-of-state facility operating in compliance with federal used oil processing regulations. The product must not have been mixed with other contaminants, must not be regulated federally as a hazardous waste, and must have contaminant concentrations below limits set forth in subparagraph (B) of paragraph (3) of subdivision (a) of Section 25250.1\*\*.

Similarly, the term “oil recycling facility” has been broadly applied to include facilities that are producing closed-loop, single-use and downcycled products. Paragraph (4) of subdivision (a) of Section 25250.1 states that a “used oil recycling facility” is any facility that reprocesses or re-refines used oil.

For the purposes of this report, we have focused on three categories of recycled oil products: recycled fuel oil, marine distillate fuel, and re-refined base lube stock. Each category represents the primary product manufactured at one of the three used oil recycling facilities in California. Asphalt is a secondary product produced from some of the recycling processes and will not be discussed in any detail.

To determine how each primary product is generated in the state, we reviewed the Part B permit applications for each facility on record with the DTSC. These permit application documents were the primary source for the facility and product descriptions provided below. For simplicity of comparison, several aspects of each recycled oil product are summarized in Table 2.

### **Recycled Fuel Oil (RFO)**

Production of recycled fuel oil (RFO), also known as “fuel oil cutter (FOC),” uses a combination of physical, chemical, and thermal treatment mechanisms to separate water and suspended solids from the used oil so that the product can be used as fuel, cutter stock, or refinery feed.

Industrial Service Oil Company, Inc. (ISOCI) is the primary facility for RFO production in California. In its process, used oil received from trucks, railcars, and containers is pumped through fine-mesh strainers, and possibly one to two gear pumps, before going through a heating unit or a filtration unit. In the heating unit, oil is heated to 180°F and treatment chemicals are applied, which separates the feed into water, sludge and oil streams. The water is pH-adjusted to allow for safe disposal, and the sludge stream is filtered to remove oil and solids from low-molecular weight liquids. The oil stream coming out of the heating/ treatment unit meets the State’s criteria for de-classifying used oil as a hazardous waste and is sold as “recycled oil.”

The “recycled oil” product is then burned as fuel oil. Because burning eliminates the future recovery of the lubricating and the energy potential of the used oil, this process is an example of single-use recycling. Also, since the fuel oil is of lesser quality than the original lube oil the

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\*\* The contaminant limits are provided in comparison with the federal limits in Table 3 (see Appendix A).

product is considered a “downcycled” product. Furthermore, because minimal concentrations of heavy metals and sulfur are removed during processing, burning RFO often produces the highest contaminant emissions from recycled used oil products and therefore is considered the least desirable reuse of used oil.

### **Marine Distillate Oil (MDO)**

Production of marine distillate oil (MDO), also called “marine distillate fuel,” or “marine diesel oil,” also uses a combination of physical, chemical, and thermal treatment mechanisms, with the additional step of distillation which separates water and suspended solids and other contaminants from the used oil so that the product can be used as fuel. The finished product is also burned as fuel oil and can thus be recycled only a single time. However, because the additional treatment process removes more heavy metals and sulfur, and removes the asphalts, the finished product is considerably cleaner than RFO.

MDO is the California Air Resources Board’s (CARB) preferred shipping fuel precisely because it has lower sulfur content than other fuel sources. MDO is considered both a single-use recycled and a downcycled product since it is also burned as a fuel, as is RFO, but the environmental impact from MDO is far less than RFO and, from a contaminant perspective, is considered generally equivalent to closed-loop recycled products.

At the main California producer of MDO, Demenno/ Kerdoon (D/K), waste oil accepted on-site is stored in an array of storage tanks. Used or recovered oils with high water content are sent from the tank farm through an atmospheric dehydrator to remove the water or produce cutter stock for bunker fuels. Waste oils with lower water content are sent from the storage tank farm into a distillation dehydrator (DD). The condensate that forms in the DD is sent to a separation tank where condensed oily water is removed from the vapor. These streams are subsequently treated; the oily water in the Waste Treatment Plant and the vapor in the Vapor Recovery Unit. The light distillates from the DD are sent through the Naptha Splitter, and the heavy oils are sent to the Vacuum Distillation (VD) unit.

The VD unit separates the MDO from the heavier hydrocarbon molecules (the asphalts). The resultant product is sent through a Lube Treatment Unit where a proprietary combination of chemical treatments and extractions are applied under vacuum to improve odor, raise the flashpoint, and improve the oxidation stability of the fuel.

The asphalts that are removed in the VD unit are a useful by-product that can be sold as an asphalt flux. These asphalts effectively sequester 94-97.5 percent of the heavy metal contaminants found in used oil.

### **Re-refined Base Lube**

Production of re-refined base lube also uses a combination of physical, chemical, thermal and distillation processes, with the addition of hydrotreating, to separate water and suspended solids and other contaminants from the used oil so that the product can be used interchangeably with virgin lube oil in lube oil applications. Re-refined base lube is considered to be closed-loop recycled.

At Evergreen Oil, Inc., the only re-refiner in California, when used oil is transported to the Evergreen facility, it is first tested to ensure that the oil meets Evergreen’s acceptance criteria before it is off-loaded into pre-select tanks. If the oil meets the recycled oil standard but is not of high enough quality to be re-refined, it is sent to the fuel blending tanks. About 5-7 percent of the

incoming used motor oil does not meet the re-refining criteria; it is usually rejected because of high silicon and phosphorous concentrations.

If the used oil is of high enough quality to be re-refined, it will first go through a natural-gas fired heater that drives off the ~five percent of water it contains. This unit is equipped with flue-gas scrubbers to control odor and gas emissions. During this step, the non-condensibles are burned off. The “dewatered oil” is sent to a vacuum distillation unit where the lighter hydrocarbon fractions are boiled off. The “degassed oil” is subjected to a proprietary process known as the “Mohawk Process” which combines a thin-film evaporation (TFE) technique with a high-vacuum distiller. As with the distillation process described for D/K, this serves to separate the lube distillate fractions from the asphalt fractions. Also as with the D/K process, this methodology effectively sequesters the heavy metals in the asphalts; however, this process is slightly more efficient at removing the heavy metal contaminants and the resultant lube distillate has approximately 98.5-99 percent of the heavy metals removed.

At this point, Evergreen can sell the product as marine distillate oil, which is a high-quality lube distillate. They can also subject the lube distillate to hydrotreating in which hydrogen is used to stabilize the hydrocarbon molecules. Hydrotreating further decreases the heavy metal and sulfur concentrations because the catalysts used in this stage will absorb most of the remaining metals. The end-product is either “100 Neutral” or “250 Neutral” base oil, both of which are deemed “water white” and have less than 100 ppm sulfur. Since the hydrotreater was first installed, Evergreen has improved the efficiency of the hydrotreatment process from about 50 percent recovery to about 75 percent recovery. The resulting lube is API-certified and can be used interchangeably with virgin lube in automotive applications.

Note that several recycling facilities outside California, including ORRCO and Bango, produce base lube oil without hydrotreating, and the resultant product does not meet current API standards. This oil can be used for industrial applications, and for this analysis is considered a form of closed-loop recycling that yields a downcycled product. It is considered downcycled in instances where used automotive oil is re-refined and the resultant product, industrial oil, is of lower value than the original automotive oil fraction collected. In instances where only used industrial oil is re-refined to new industrial oil, this processing is considered closed-loop but the product is not considered downcycled.

**Table 2: Comparison of Recycled Oil Products**

Product	Treatment Mechanisms	Relative Contaminant Concentrations	Product Rating
Recycled Fuel Oil RFO	Dehydration Filtration	Highest heavy metal and sulfur concentrations	Single-use Recycling Downcycled Product Results in heavy metals and sulfur emissions
Marine Distillate Oils (MDO)	Dehydration Filtration Distillation	Intermediate concentrations of heavy metals and sulfur Asphalts removed	Single-use Recycling Downcycled Product Low environmental impact

Product	Treatment Mechanisms	Relative Contaminant Concentrations	Product Rating
Re-refined Industrial Base Lube	Dehydration Filtration Distillation	Intermediate concentrations of heavy metals and sulfur Asphalts removed	Closed-loop Recycling Potentially Downcycled Product Depending on Used Oil Source Low environmental impact
API-certified Re-refined Base Lube	Dehydration Filtration Distillation Hydrotreatment	Lowest concentrations of heavy metals and sulfur Asphalts removed	Closed-loop Recycling Maintains original used oil quality Low environmental impact

### Energy and Environmental Considerations

Several organizations have published facts illustrating the need for the proper disposal of used oil. Often used for perspective are the examples that one gallon of used motor oil can:

- Create an eight-acre oil slick
- Contaminate approximately one million gallons of fresh water (the estimated annual drinking water demand of 50 people)

In addition, the energy contained in two gallons of used motor oil is often cited as reasons to recycle it. Two additional facts illustrate the advantages of re-refining relative to virgin lube products:

1. According to the U.S. Environmental Protection Agency (EPA), one gallon of used motor oil can yield the same 2.5 quarts of lube oil obtained from refining 42 gallons (one barrel) of virgin crude.
2. The American Petroleum Institute states that it takes 50-85 percent less energy to produce a lubricant through re-refining used oil than to produce that same volume by refining virgin crude.

The advantages of re-refining have been supported by numerous studies published in recent years. Several of these, summarized below, support CIWMB's stipulation that recycling to the equivalent quality of base lube oil is the "highest and best use" for used oils because re-refining provides the greatest measure of energy savings, environmental protection, and sustainability.

#### Boughton and Horvath (2004)

In their end-of-life scenario of used oil management strategies in California, Boughton and Horvath (2004) found that re-refining and MDO impacts on air quality are approximately equivalent and both are significantly better than burning RFO.

*Fehrenbach (2005)<sup>††</sup>*

This European report assessed the ecological and energetic aspects of re-refining based on five different re-refining techniques. The results of this Life Cycle Assessment (LCA) indicated that all five re-refining techniques offer considerable environmental advantages relative to the production of base oils from virgin crude. Furthermore, the environmental benefits of re-refining were greater with an increasing ratio of synthetic and semi-synthetic oils in the used oil stream, an assertion supported by the chairman and CEO of Evergreen Holdings (Evergreen Oil) (Voogd and Magnabosco, 2006). The report also pointed out that direct burning, such as burning RFO, is advantageous compared to burning coal, and that diverting these combustion oils to re-refining would not be advantageous if the combustion fuel is replaced by coal.

*DOE (2006)*

In Chapter 7 of their “Used Oil Re-refining Study to Address Energy Policy Act of 2005 section 1838,” the DOE summarized several previous research efforts into the benefits of re-refining. Its analysis of this body of earlier research “supports re-refining as the best solution from both energy resource preservation and environmental conservation perspectives.”

*ENSR (2008)*

As part of the effort to manage the carbon footprint of its operations, Safety-Kleen, the largest used oil re-refiner in North America, commissioned ENSR to estimate the greenhouse gas (GHG) emissions of its East Chicago, Ind., re-refinery. In its analysis, ENSR compared re-refining with lubricant production from virgin crude. The analysis found that when the GHG costs of used oil disposal are accounted for, re-refining to base lubricant produces approximately 20 percent of the emissions relative to the production of an equivalent volume of lubricant from virgin oil.

### **Testing and Reporting Requirements**

According to subparagraph (D) of paragraph (3) of subdivision (a) of Section 25250.1 of the Health and Safety code, anyone authorized by the department to recycle oil must maintain records of incoming used oil volumes, the characteristics of the incoming used oil, and the volumes of recycled oil produced. More specific requirements are mandated by Section 48673 of the Public Resources Code (part of the CORE Act legislation), which requires facilities to report used oil and recycled oil volumes on a quarterly basis to CIWMB. A sample of the quarterly reporting form is provided in Figure 3.

Additional, bi-annual reporting requirements are outlined in Section 25250.17 of the HSC, which states that each used oil recycling facility must submit a report by March 1 of every even-numbered year that includes, among other details, the following information:

- Total volume of oil received during the preceding calendar year
- Total volume of oil recycled during the preceding calendar year according to several categories: reuse as a petroleum product, consumed during processing, reuse as something other than a petroleum product, and the volume transported offsite without being recycled

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<sup>††</sup> This report was commissioned by the Groupement Européen de l’Industrie de la Régénération (GEIR) and has been referred to in other reports as the GEIR Report, or cited as GEIR (2005).

This same report must also include the mechanisms by which the recycled oil products and wastes were produced. As outlined in Section 25250.19, each used oil recycler must also maintain records of compliance testing for three years; these records are subject to audit and verification by the DTSC or CIWMB. Testing of the recycled oil products ensures that the product complies with the purity standards referenced earlier for lead, arsenic, chromium, cadmium, halogens, PCBs and flashpoint (subparagraph (B) of paragraph (3) of subdivision (a) of Section 25250.1 of the HSC). (See Table 3 in Appendix A.)

Used oil haulers are also subject to the testing and reporting requirements of both the PRC and the HSC. Section 48672 of the PRC places similar quarterly reporting mandates on haulers to report to CIWMB the volumes of used motor oil and used industrial oils, in addition to listing the locations where the oil was received and where it was delivered. The section of the HSC dealing with used oil transport (Section 25250.18) requires haulers to maintain shipping certification forms that include the receiving facility's name and address, the quantity shipped, the date of shipment, and any cross-referencing information to the used oil shipment. These records are also subject to audit and verification and must be maintained for three years.



**USED OIL RECYCLING FACILITY REPORT FORM**

<b>A. Print Legibly or Type</b>	
1. EPA Identification Number	
2. Company Name	<b>Reporting Period:</b>  <b>July 1 to September 30, 2006</b> <b>Due October 31, 2006</b>
3. Mailing Address	
4. Street Address (if different from above)	
5. Contact Person	6. Contact Person's phone number ( )

<b>B. Total Amount of Used Oil Received During This Reporting Period</b>			
	Within California	Outside California	
Lubricating Oil (includes: motor oil, transmission fluids, oil used in internal combustion engines)	7.	10. 11. Name of State or Country	15. Total (add lines 7 and 10)
Industrial Oil (includes: hydraulic fluids, refrigeration oil, metal working oil)	8.	12. 13. Name of State or Country	16. Total (add lines 8 and 12)
	9. Total (add lines 7 and 8)	14. Total (add lines 10 and 12)	17. Grand Total (add lines 9 and 14)

<b>C. Total Amount of Recycled Oil Produced by the Facility</b>		<b>D. Total Amount of Residual Material Produced by the Facility (include constituents of the used oil which remain after processing)</b>	
Re-refined as neutral base stock	18.	Produced as a non-hazardous waste (e.g., water)	24.
Re-refined as industrial oil	19.	Produced as a hazardous waste	25.
Processed into fuel oil	20.		26.
Processed into asphalt	21.	Other (please specify)	27. Total (add lines 24 through 26)
Consumed in the process of preparing it for re-use (including being burned for energy recovery)	22.		28. Grand Total (add lines 23 and 27)
	23. Total (add lines 18 through 22)		

<b>E. Total Amount of Used Oil Transferred to Another Facility for Processing and Treatment</b>	
29. USEPA ID Number	32. USEPA ID Number
30. Name of Facility	33. Name of Facility
31. Gallons Transported	34. Gallons Transported

<b>F. SECTION TO BE COMPLETED BY PERSON AUTHORIZED TO PREPARE THIS REPORT</b>	
Certification: I certify to the best of my knowledge that the submitted information is true, accurate, and complete	
61. Print/ Type Name	62. Title
63. Signature	64. Date

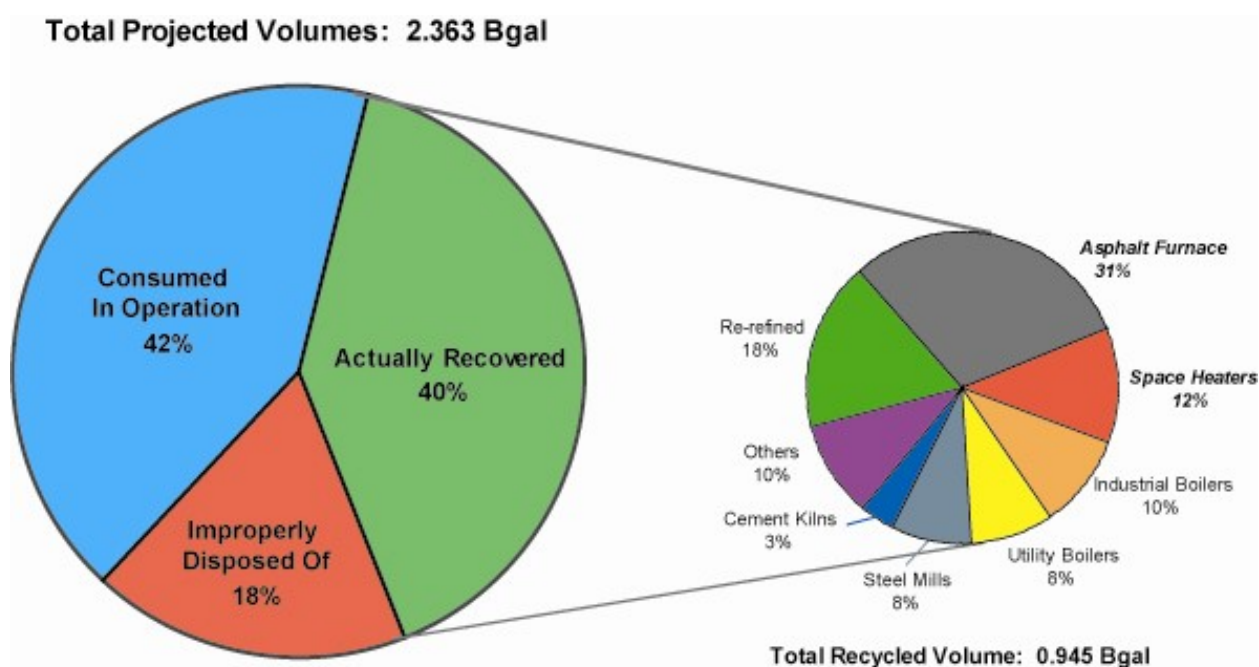
**Figure 3. Quarterly reporting form for recycling facilities.**

## Used Disposition and Demand

Despite the fact that re-refined oil offers significant energy savings and greater environmental benefits, most used oil that is collected is burned as a fuel oil. This trend is true for both the national and California markets.

### National Disposition Trends

In its recent study of the energy and environmental benefits of re-refining used lubricating oils, DOE summarized the dominant methods of used oil disposition (DOE, 2006). As shown in Figure 4, 82 percent of the used oil that is collected is combusted whereas only 18 percent is re-refined.



**Figure 4. Estimated disposition for national used oil market.**

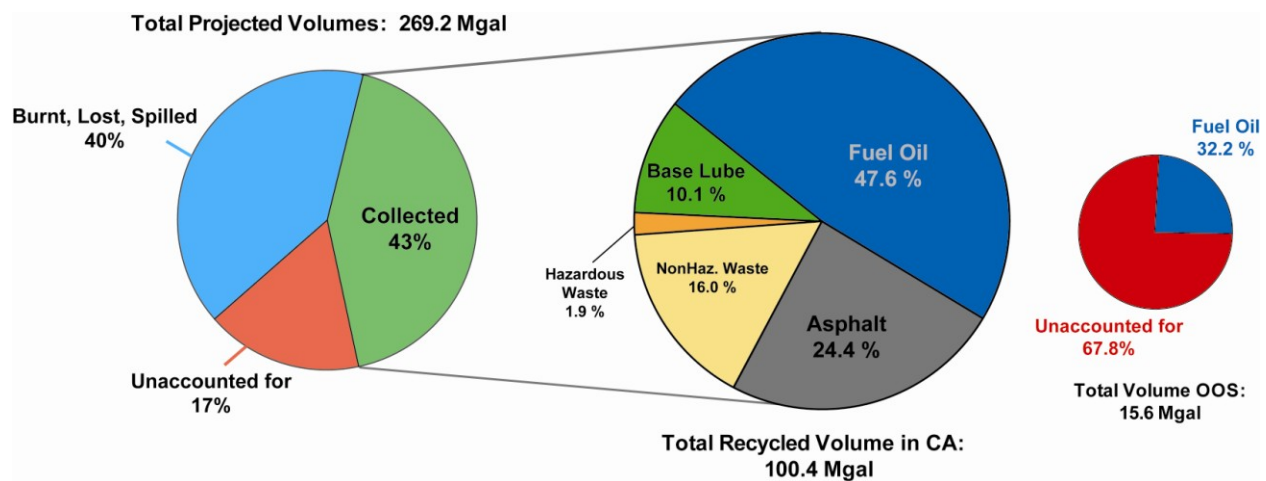
For the small pie chart, all applications, except re-refining, are processes for using the oil as combustion fuel. Data from DOE (2006).

Another way to calculate the used oil disposition trends is to compare the amount of each end-use to the amount *available* for recycling. In other words, if the oil is consumed during operation, there is no way to collect it, much less recycle it, and thus it should be removed from the estimate of used oil collected or recycled. For the national market, 0.992 billion gallons are consumed during operation each year, leaving 1.371 billion gallons for recovery. In Figure 4 above, the percentages of end-uses are relative to the amount actually recovered. If the amount *available* for recovery is considered, re-refining only accounts for approximately 12 percent of the used oil market.

Also note that in Figure 4 the volume of “improperly disposed of” oil was calculated as the balance remaining after the volume of “recovered” oil was subtracted from the volume *available* for recovery. In other words, no investigation was conducted to measure the amount of used oil improperly disposed of. A more accurate description of the balance is “unaccounted for,” which is a category CIWMB uses in the accounting of used oil volumes.

### California Disposition Trends

Although fewer details are known of the end-use market for the fuel oils produced from used oil in California, it is clear that fuel oil is the dominant product (Figure 5). Similar to national trends, re-refined oil typically accounts for less than 10 percent of the recycled oil that is produced in California.



**Figure 5. Estimated disposition for the California used oil market in 2006. OOS = Out-of-State. Data from CIWMB (2006 and 2007).**

Note from Figure 5 that “fuel oil” is not subdivided into RFO and MDO. The data charted here came from the quarterly reporting forms submitted by each recycling facility certified in California (see Figure 3). No distinction is made between RFO and MDO on the reporting form and so it is impossible to report official volume estimates of these individual products.

The out-of-state estimates in Figure 5 highlight a serious difficulty with tracking used oil volumes leaving the state, and with enforcing California regulations outside of California. The volumes reported here represent the amount of used oil being shipped directly from a generator to an out-of-state facility. It does not account for used oil shipped from a transfer facility. Estimates of out-

of-state shipments obtained from DTSC indicate that 27.7 Mgal of used oil were shipped out of state in 2006, the year summarized in the above figure<sup>\*\*</sup>.

Additionally, out-of-state facilities are not required to submit the same quarterly reporting forms as in-state facilities. The estimates of “Fuel Oil” in Figure 5 come from the voluntary reporting of two Oregon facilities, but these volumes only account for 32 percent of the used oil shipped out of state. Although it is difficult to verify what happens to the other 68 percent, various Californian stakeholders speculate that, based on the nature of the facilities that receive the oil, virtually all of the used oil being shipped across state lines is recycled as RFO.

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<sup>\*\*</sup> This estimate was obtained through a Public Access Request of the used oil manifested out-of-state. Additional data obtained through this request are provided in Appendix C.

# Oil Blending

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## ***Feasibility***

When this evaluation was initially proposed, CIWMB wanted an evaluation of the technical and regulatory barriers to blending used oil into crude oil prior to the crude entering a standard refinery. The goal was to decrease the amount of used oil being burned for energy recovery and emitting heavy metal contamination. By blending into crude oil streams, the used oil would be closed-loop recycled because it would be refined back into lubricating products.

This idea is not unrealistic. As part of the recommendations to CIWMB, the Cal Poly group mentioned oil blending as a possible method to increase the conservation of used oil as a resource, and thus increase the Used Oil Program's fulfillment of the ultimate legislative goals of the CORE Act (Cal Poly, 2005). Also, a recent industry publication mentions that Chevron's Gulf Coast unit has installed the necessary operations to upgrade used oil so that it can be blended with crude and is refining this blended stream (Briggs, 2007).

There are a variety of reasons why blending of used oil is not a more common practice. The technical reasons relate to the contaminants present in used oil and to the sensitivity of the crude oil refining process. The regulatory barriers relate to the hazardous waste classification in California.

## ***Technical Barriers***

Recall that used automotive and used industrial oils have different chemical compositions, primarily in terms of heavy metal concentrations. Although many of the same metals are found in both categories of oil, zinc is one metal found primarily in used automotive oils because it comes from the additive packages that are added only to motor oils. Specifically, zinc dithiophosphates serve as antiwear and anticorrosion agents and as antioxidants (DOE, 2006).

Because zinc is rarely found in crude oils, refinery catalysts are rarely developed to deal with this particular heavy metal. One concern is that the zinc in the used oil will poison the catalysts. Altering the refinery operations to deal with new sources of catalyst poisoning is an extremely expensive undertaking that major refineries are reluctant to perform.

One approach to dealing with this technical barrier is to remove the zinc from the used oil before blending it with the crude. To evaluate the feasibility of such an approach, we met with Pacific Operators, Inc., a small oil exploration and production company in the Santa Barbara area. They were interested in potential ways to upgrade and blend used oil with the crude they were extracting from offshore rigs. However, this approach was not explored since it would need to overcome numerous technical, regulatory, and industry hurdles in order to become feasible and was beyond the modified scope of this effort.

## ***Regulatory Barriers***

According to Bob Boughton with DTSC, one of the major oil companies in California at one point investigated the possibility of blending. Although we have not seen a copy of the research report, more than one individual has conveyed that the blending effort was abandoned because of the regulatory burdens in California.

California has adopted used oil management standards that are stricter than the federal regulations. California, along with only one other state, classifies used oil as a hazardous waste.

As part of the permitting and certification process to be able to accept used oil hazardous waste, a facility must submit documentation and go through a public comment period. Given the public relations and permitting difficulties with altering refinery operations, California refineries are generally unwilling to go through the steps necessary to receive hazardous wastes since there is no clear market incentive to do so.

## ***Project Evolution***

Several factors led to a de-emphasis on using existing refineries to process used oil. First, we learned that a major oil production company had already investigated this approach and chose not to pursue it in California, although used oil upgrading and blending is occurring in at least one other state. Second, given the low volumes of used oil compared to crude, refineries have little motivation to overcome the regulatory obstacles to accepting hazardous waste.

Despite these two realizations, we were prepared to investigate other options for overcoming both the technical and regulatory barriers of blending used oil with crude, especially given the initial enthusiasm expressed by Pacific Operators to help move the project forward. However, the disclosure from Evergreen Oil, Inc., California's only re-refiner, that it did not consider itself to be primarily limited by capacity caused a shift in the direction of research.

# Optimizing “Highest and Best Use”

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The original project tasking was based on the assumption that the amount of oil being re-refined was limited by installed capacity, and that blending used oil with crude would be taking advantage of a larger capacity. However, during early interviews, Gary Colbert of Evergreen Oil, California’s only re-refiner, indicated that this assumption was flawed. He informed us that he had been permitted to double his facility’s capacity and that, once the expansion is operational in 2008, he will need an additional volume of incoming used oil to operate at capacity. Colbert also expressed his intent to build a second facility in Southern California if more used oil becomes available.

Combined with the resistance from the major oil refineries to accept used oil, this information led to a re-evaluation of how to achieve the project goal of increased closed-loop recycling of used oil.

## ***“Highest and best use”***

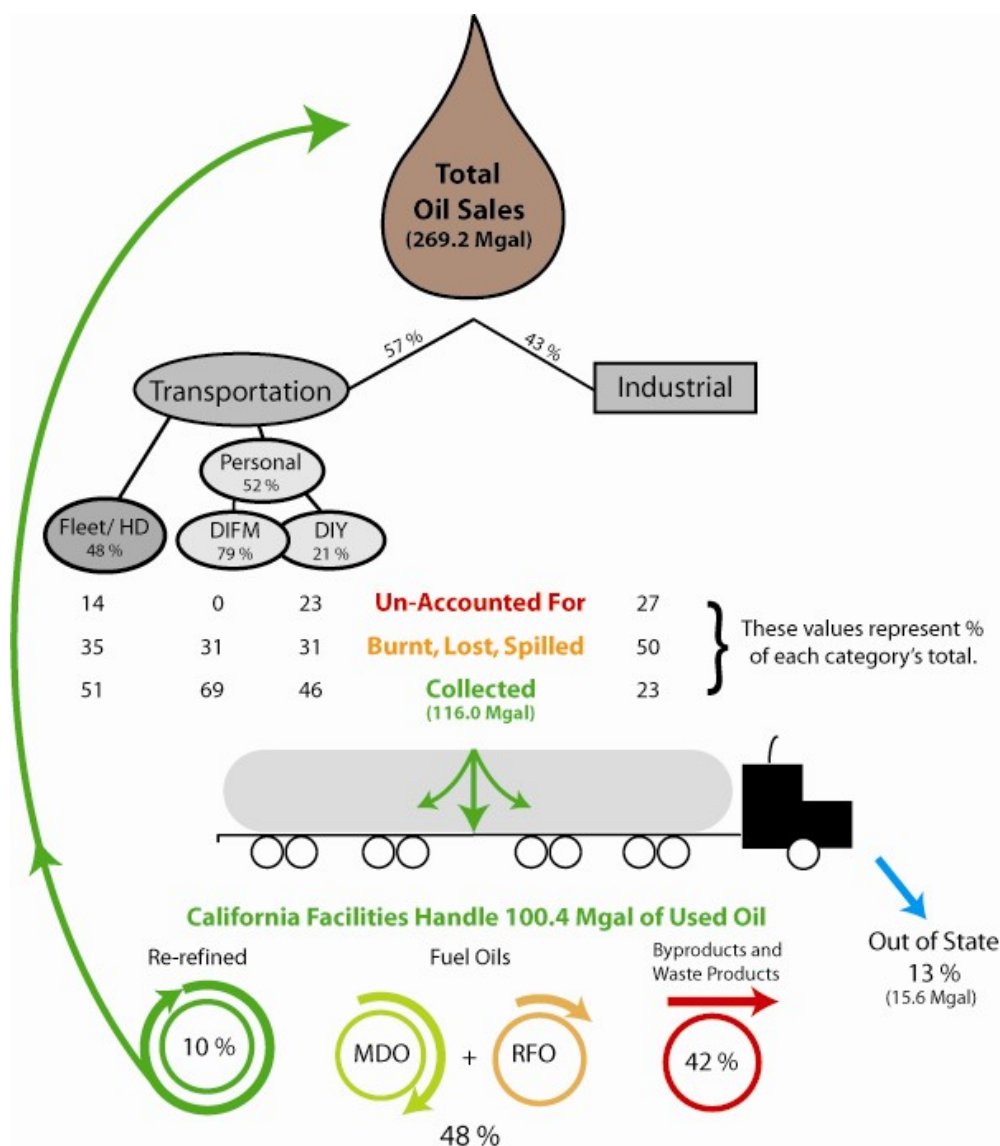
As previously stated, the revised project agenda focused on how to ensure that recycled oil products represent the “highest and best use” of used oil. CIWMB defines “highest and best use” as “closed-loop recycling” since it has both the lowest environmental impact and the highest sustainability. This stipulation is consistent with numerous studies suggesting re-refining as the best management strategy for used oil. Boughton and Horvath (2004) and GEIR (2005) cite increased air quality as justification for recommending re-refining over direct-burning of RFO. The DOE (2006) report cites energy conservation as justification for recommending re-refining used oils compared to refining virgin crude.

## ***Limitations***

Not all oils are easily re-refined depending on the chemical characteristics. For some oils, the energy required for re-refining offsets any potential energy advantages relative to virgin products. For these oils, the “highest and best use” is *not* to be re-refined, but instead to be distilled into industrial oil or MDO. In fact, Boughton and Horvath (2004) found that, in terms of environmental effects, MDO and re-refined oil are approximately equivalent. With the phrase “highest and best use” narrowly defined to include only closed-loop processes, the potential exists that optimizing the used oil system only for re-refining may not optimize for the lowest environmental impact.

# Used Oil System in California

With the modified tasking clearly outlined, we proceeded to analyze the dynamics of the used oil market in California. Figure 6 illustrates the flow of oil through the system from the point of sale until it is sold as a “recycled oil product.”



**Figure 6. California's used oil system, 2006.**

Volumes as percentages of respective category's total. A detailed discussion of how these numbers were derived is presented in Appendix B. Data from CIWMB (2007).

Several features of this flow diagram merit discussion.

1. It's clear by the zero percent "Unaccounted For" in the quick lube category that these businesses are heavily regulated and that the regulations effectively eliminate any illegal disposal.
2. The highest percentage of "Unaccounted For" oil is in the Industrial Oil sector.
3. Official estimates of the different types of fuel oils are not available; referring back to Figure 3, note that the form does not require the facilities to distinguish between MDO and RFO.
4. Included in the "Biproductions and Waste Products" are asphalts, non-hazardous waste, and hazardous wastes.

## ***Reservoir Volumes and Fluxes***

The discrepancy between volumes of oil sold and recycled in California has been recognized at least since 1978 when the State passed legislation to increase awareness of oil recycling. Since then, CIWMB has tracked not only oil sales and volumes recycled, but also estimates of how much is lost to operations and how much is unaccounted for.

Although some of the volumetric information was presented earlier (see Figure 5), the more detailed accounting of used oil generation included in [Figure 6](#) highlights several aspects of the used oil system.

1. Slightly more oil is sold for use in private vehicles than for use in heavy vehicles/ fleet operations.
2. All of the oil sold to private vehicles that is recovered at do-it-for-me (DIFM) quick lube stations is accounted for, whereas 23 percent of the oil sold to do-it-yourselfers (DIY) is unaccounted for.
3. There is a much higher percentage of industrial oil consumed during operation than in the automotive sector.
4. The volume of industrial oil unaccounted for is greater than the amount collected for recycling.

## ***Stakeholders***

While it is important to consider the volumes of used oil managed within California, another way to view the system is to consider the various stakeholders. In Figure 6 it is easy to see who the stakeholders are, and how the interests of different stakeholders affect each other and the system as a whole.

### **Generators**

Oil enters the system when it is bought for use. The purchaser could be an individual vehicle owner, a heavy fleet manager, or an industrial user. Once they have used the oil, the purchasers are considered "generators" of used oil.

### **Collectors**

A business may collect used oil from the public if they have the proper permits issued by local hazardous waste regulatory programs overseen by Certified Unified Program Agencies (CUPAs).

A business that collects used oil from the public may also be registered with CIWMB as a certified collection center (CCC), although belonging to the CCC program is not required. Many CCCs that collect used oil from the public are also generators of used oil, such as automotive garages or quick lube oil-change DIFM businesses.

A collection center is permitted to receive and store limited volumes of used oil for limited amounts of time. After the center has either (a) reached its permitted volume, or (b) been storing the used oil for the permitted time limit, the oil is transported to a recycling facility by a certified used oil hauler.

### **Haulers**

There are more than 150 companies certified by the State to transport used oil within California. Several of these companies are affiliated with a specific recycling facility. For instance, Evergreen Oil and Demenno/ Kerdoon each operate a hauling service which is the primary transporter of used oil into these facilities. These are probably the two largest transporters in California.

In addition to a handful of companies that transport very large volumes of used oil, there are more than 100 certified independent haulers. These companies have a choice of where to take the used oil. Many of the independent haulers surveyed for this report indicated that they are willing to transport their used oil across state lines because out-of-state recycling facilities are willing to pay more for the used oil than in-state facilities.

### **Recycling Facilities**

The recycling facilities within California have been described in detail elsewhere in the report. Briefly, there are three used oil recycling facilities in the state: Evergreen Oil is the only re-refiner, Demenno/ Kerdoon is the primary producer of MDO, and Industrial Service Oil Company, Inc., manufactures RFO. Of these, only the process at Evergreen is considered closed-loop recycling.

### **Incentives**

As part of the CORE Act of 1992, CIWMB was required to establish an incentive program to encourage the collection and proper disposal of used oil. The program has not changed since it was first implemented: for every quart of used oil brought to, or generated at, a certified collection center (CCC), the center is supposed to pay \$0.04. The funds to pay the recycling incentive come from a \$0.04/ quart (\$0.16/ gallon) fee levied on all lubricating oil sold in California. Because a fee is levied on all oil sold, and the volume sold is much greater than the volume collected through the CCC network, there is a surplus available in the Used Oil Fund that is used to pay for the operation of the Used Oil Program and to fund multiple grant opportunities that promote used oil recycling.

The recycling incentive is clearly designed to encourage DIY oil changers to bring their used oil to a CCC. Two recent studies commissioned by CIWMB have found that the recycling incentive is ineffective. The Public Research Institute at San Francisco State University (2002) found that monetary rewards are strong incentives for DIYers to properly dispose of their oil. However, they also found that the amount of an effective monetary incentive ( $\geq$  \$1.00/ gallon) is much greater than the \$0.16/ gallon currently offered (San Francisco State, 2002).

Supporting this finding, the Cal Poly group reported that the incentive is rarely offered to DIY oil changers but instead the CCCs usually keep the modest incentive payment to defer the costs of accepting used oil from the public (Cal Poly, 2005).

The Cal Poly (2005) study recommended re-evaluating, and possibly eliminating, the recycling incentive. Having interviewed numerous CCC stakeholders for this project, we feel that eliminating any financial incentive for the CCCs to accept used oil from the public would cause many of the CCCs to withdraw from Used Oil Program. With fewer locations available that accept used oil, we believe that would result in an increase in illegal disposal from DIYers. Thus, removing the financial incentive for CCCs would likely negatively impact the environment.

On the other hand, re-evaluating the role of the incentive has been a key component of the present assessment. Since the program inception, the incentive has served to promote used oil collection by encouraging the top tier stakeholder, meaning the generator, to take the oil to a specific locality or manage it a certain way at the generating facility. The fact that the incentive only applies to the collection portion of the flow diagram in Figure 6 illustrates that there are other areas of the system that could be improved through incentives.

## **External Factors**

There are numerous factors affecting this system that are not explicitly a part of the system in Figure 6, but have significant impacts to the way the system operates.

### **Lube Oil Supply**

There is some stakeholder concern that increasing the production of California's re-refined lube oil will only displace virgin lube oil production and major oil companies would then resort to producing greater volumes fuel oil from their crude stocks (Boughton and Horvath, 2004; Jim Ennis, personal communications, 9 April 2008; R. Hoffman, personal communications, April 28, 2008). They claim this shift would be energy inefficient and environmentally regressive because it takes substantially more energy to produce lube oil from used oil than from virgin crude oil, and because virgin lube oil, which is derived from crude oil with little processing, would in turn be converted into fuel oil to satisfy the MDO market. (R. Hoffman, personal communications, April 28, 2008)

Also of concern is whether a market exists for increased lube oil production through recycling since the California crude oils are known to have high lube fractions and therefore major oil companies produce the majority of California's lube oil demand.

There is little evidence that supports these concerns about energy and market impacts. For California's major oil refineries to shift operations away from lube production would require a decrease in demand not only in California, but worldwide. California's lube oil production has remained fairly constant over the last several years, despite national trends of decreasing demand. Over the last several years, only North America and Western Europe have experienced a decrease in lube oil demand (Tocci, 2008). The increase in demand in other parts of the world, notably the Asia Pacific region, will continue to provide a market for the higher-valued lubricant product produced at the major refineries (Ibid.). Furthermore, although North American demand decreased by 2.5 percent from 2005-2006, the United States is still the largest market for lube oils (Ibid.).

In Chapter 7 of "Used Oil Re-refining Study to Address Energy Policy Act of 2005 section 1838," DOE summarized several previous research efforts into the benefits of re-refining. The analysis of this body of earlier research "supports re-refining as the best solution from both

energy resource preservation and environmental conservation perspectives.” Furthermore, the American Petroleum Institute states that it takes 50-85 percent less energy to produce a lubricant by re-refining used oil than to produce that same volume by refining virgin crude – which directly contradicts the stakeholder energy concerns.

Also, according to Sheridan (2006), 51 percent of the crude produced in California is considered “heavy” crude and the fractions of lube are approximately equal volumetrically to the middle distillate fractions. Sheridan (2006) also pointed out that, since 1994, California has imported more crude into its refineries than it produced in-state. Therefore, shifting supply of the lubricant demand towards re-refined oil is independent of the quality of California crudes.

In discussions with stakeholders involved with selling lube oil, we have been repeatedly told that they can sell every drop of API-certified lube oil that can be produced from California’s used oil.

### **Air Quality Regulations**

Improving air quality has been the goal of a considerable volume of legislation at both the national and state level. This affects both the permitting of recycling facilities and the quality of fuel oil industrial applications are required to use.

Regulations concerning air quality in California are some of the most stringent in the country. As air quality controls have improved, it has become increasingly difficult to develop or install new used oil recycling capacity. During telephone and personal interviews for this project, several industry representatives cited increasing air quality restrictions as barriers to increasing oil recycling capacity.

Air quality regulations also affect the quality of the fuel oil industrial applications are required to use. In 2007, the EPA Office of Transportation and Air Quality announced that it will be promulgating new emission standards for certain marine engines based on its finding that marine diesel engines “contribute significantly to air pollution in many of our nation’s cities and towns.” (EPA, 2007a and 2007b). The rules will likely take effect in 2009 (EPA, 2008). The new standards will be met by a combination of new engine technology and low-sulfur diesel fuels. The EPA emission regulations are impacting California’s used oil system since to meet these standards, producers of marine distillate fuel will likely have to increase the steps for processing used oil.

### **Permitting Difficulties in California**

In addition to air quality limitations, numerous stakeholders cited difficulties with obtaining other permits as a barrier for increasing re-refining capacity in California. Robert Sulnick, representing Evergreen Oil, indicated that the permitting process took seven years for Evergreen to expand its re-refinery operations in Newark, Calif. On behalf of Evergreen, he recommends streamlining the permitting process. In addition to increasing the time for additional re-refining capacity to come online, the current process also adds considerable cost to an already expensive permitting process.

Bill Ross of Safety-Kleen indicated that California’s permitting and other requirements make it extremely difficult, if not impossible, for a new re-refinery, or refinery, to be constructed in California. In addition, he noted it is extremely difficult for a truck-to-rail transfer facility to obtain a hazardous waste permit in California, which is essential for the economic transport of large quantities of used oil to an out-of-state re-refinery. Although Safety-Kleen provides a collection service to many clients within the state, much of the oil they collect is processed by D/K; the only oil transported to its East Chicago, Ind., re-refinery is that oil that must be re-refined to base lube per the contract with the customer.

## **API Standards**

All automotive base lubes produced from used oil must meet the same standards set forth by the American Petroleum Institute (API). Currently, there are several categories of API-certified petroleum products. These categories are based on the amount of saturated hydrocarbons and the sulfur concentration. Automotive lubricants are currently classified as Group I or Group II oils, with Group II oils being a higher quality product. An industry representative indicated that API soon would be releasing standards for a Group II+ category that has a higher concentration of saturated hydrocarbons and a lower sulfur concentration than the Group II oils.

As the standards change, recycling facilities must either adapt or improve their processing capabilities, or cease to produce API-certified base oils. With the upcoming Group II+ standards, Evergreen Oil has included process modifications in its facility expansion to continue producing high-quality base oils. However, past changes in the API standards caused Demenno/ Kerdoon to stop production of base oils, as it would need to add hydrotreatment to its process to meet current API standards.

## **Hazardous Waste Classification**

Used oil destined for a recycling facility is not considered a hazardous waste at the federal level. California is one of only two states that classifies used oil as a hazardous waste. The advantages of this classification are that it allows for better tracking of the used oil volumes relative to other states precisely because it is subjected to tighter regulation, and it offers a higher degree of environmental protection. Jim Ennis, of D/K, noted that before California managed used oil as a hazardous waste, there were numerous locations with extensive pollution related to improper used oil handling; since California began managing used oil as a hazardous waste, no such locations have been observed (Jim Ennis, personal communication, April 9, 2008). However, there is no evidence of a direct connection between the hazardous waste designation and the elimination of used oil pollution, as even states that do not classify used oil as a hazardous waste have seen significant improvements in used oil handling.

There are also several disadvantages that stem from California classifying used oil as a hazardous waste. Accompanying this more stringent classification are more stringent standards for de-classifying used oil as hazardous. It contributes to higher operating costs for in-state used oil recycling facilities. The added cost is not just from additional testing, but also from:

1. The requirement to establish a site-closure trust fund; this can cost \$2 million to \$3 million.
2. The administrative costs of reporting to various State regulatory agencies.
3. Regular mandatory inspections of the secondary containment, container thickness, piping, valves, and hoses.
4. Operating under a Waste Analysis Plan. (ibid.)

A second disadvantage is that it limits the range of viable approaches for responsible recycling. The strict regulation of locations where responsible used oil transfers may occur results in some transportation inefficiencies. Most independent haulers are not permitted to transfer oil between trucks, or between containers and trucks, and must either haul their product directly to an in-state facility or to a facility in a neighboring state. For independent haulers, this presents a significant barrier for their business. In addition, because in-state facilities incur the added cost of testing the

oil and meeting California environmental standards, they pay independent haulers less than out-of-state facilities. The amount of oil being shipped out of state is therefore impacted.

Nonetheless, California recyclers' feedback on the topic of used oil classification as a hazardous waste was heavily weighted toward the view that the benefits for environmental protection exceeded the associated costs and handling restrictions. Out-of-state recyclers' feedback was that the hazardous waste classification resulted in unnecessary cost and handling burdens for recycling. All stakeholders indicated they do not believe it is possible politically to eliminate or modify California's used oil hazardous waste classification and, for that reason, should not be pursued as part of this analysis.

# Mechanisms to Increase Closed-Loop Recycling

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The market limitations of the recycled oil system in California are complicated. Our early discussion with key stakeholders led us to interpret California's used oil market as being only demand-limited, which we understood to be that there was not enough demand for closed-loop recycled products in order to justify expansion of production capability. Later discussions focused on the inability for closed-loop recyclers to compete with other recyclers, especially out-of-state recyclers, for the limited amount of used oil being collected. Eventually discussions evolved that indicated that re-refining production is not limited by demand, but by capacity. Lubricant companies supported the capacity limitation characterization by claiming they can sell every drop of re-refined lube oil, but only at a certain price. In reality, each of these components has complicated dynamics and interdependencies that need to be considered and included in system optimization to avoid creating a bottleneck to expanding closed-loop recycling in California.

Once we were able to better understand the dynamics and interdependencies in the used oil system, a number of broad strategies dominated the potential approaches for increasing the amount of used oil being closed-loop recycled:

1. Increase the volume of used oil available for re-refining.
2. Increase market demand for the closed-loop recycled product.
3. Increase capacity to meet the needs of greater closed-loop product production.

Within each broad strategy, numerous mechanisms were considered to help increase closed-loop recycling of used oil. These mechanisms are discussed below and were evaluated for the best and most feasible options in making our final recommendations.

## ***Premise to Market-based Mechanisms: Re-evaluate the fees collected***

Without regulatory mandates, influencing the current used oil market will require adequate CIWMB resources. The current fee collected on used oil sales was originally implemented in 1992 and has not been re-evaluated to meet the increased costs associated with the used oil recycling program. The incentive has primarily focused on improving used oil collection but CCC payments have not kept pace with the increased costs of being a used oil collector. For example, in 1992 the average cost of gasoline in California was \$1.52 (adjusted to 2007 dollars) whereas the average for 2007 was twice that (\$3.08) (CEC, 2008). Thus, the increased cost of transporting used oil from the CCCs has exceeded the incentive which is based on 1992 market forces.

In order to improve closed-loop recycling, additional fees will have to be collected on lube oil sales. The fee increase should be connected to the costs associated with improvements adopted for the used oil recycling program. Depending on the improvements adopted, it could be structured into two components:

- An increased collection fee that would include the CCC incentive plus the cost of additional collection efforts
- An increased recycling fee that would include the cost of the recycling incentives.

## ***Increase Volume of Used Oil Available for Re-refining***

### **Increase Collection Efforts**

Increasing the volume of used oil collected will allow more used oil to undergo close-loop recycling without reducing the amount currently going to other recycled oil products. Therefore, measures that increase the volume collected have the most stakeholder support because they do not require any stakeholder sacrifice. As noted in the Cal Poly (2005) report, there has been considerable progress in collecting used oil generated within California. Nonetheless, a significant fraction of the used oil remains uncollected and much of that oil is suspected to be improperly disposed. Improperly disposed oil results in significant environmental contamination. Greater efforts are needed to improve used oil collection from DIY consumers who are still unwilling to bring their used oil to a certified collection center. Both Evergreen and Safety-Kleen have previously documented the need to expand current collection efforts.

One area that has significant potential to increase the amount of used oil collected is curbside collection programs. Curbside programs reach many of the DIY consumers who are unwilling to bring their used oil to a certified collection center. In fact, a recent study on the used oil recycling behavior of DIY oil changers found that curbside collection programs essentially eliminate illegal disposal (San Francisco State University, 2005). Despite this success, only half of the counties in California have curbside used oil collection programs (See Appendix D).

Given the documented success that such programs have, increasing the number of curbside collection programs should significantly increase the volume of DIY used oil collected and significantly decrease the suspected environmental contamination. Consumers would need clear instruction about what is eligible for used oil curbside pickup to prevent contamination with other chemicals that ruin the value of the used oil collected. Communities that have effectively implemented such a program should be utilized as a template for expanding curbside collection to the larger California community. Furthermore, the lessons from a community-based social-marketing pilot study that significantly increased DIY participation in an existing curbside collection program should be investigated for its applicability to other communities (CSSM, 2006).

### **Encourage Hauling to Re-refinery**

Hauling is the linkage from the CCC to the recycling facilities. If haulers bring greater volumes of used oil to a closed-loop recycler, the volume of used oil available for re-refining would increase. Increasing the volumes hauled to closed-loop recyclers, without increasing the total volume collected, would result in less used oil available to other recyclers. Of the three used oil recycling facilities within California, two operate, or are affiliated with, a hauling service that provides used oil delivery. For Evergreen Oil, 92 percent of the incoming used oil is collected by Evergreen Environmental Services. Similarly, Asbury Environmental Services, a sister company of Demenno/ Kerdoon, claims to be the largest waste oil hauler in California.

When these facilities receive used oil from trucks operated by their own company, the cost of the used oil hauling is incurred by the company. However, there are more than 100 independent haulers certified to transport used oil in California. These independent haulers collect used oil from various locations and are paid by delivering it to various recycling facilities. Several independent haulers surveyed indicated that they transport their used oil out of state because those recycling facilities pay more than in-state recycling facilities. Lists of the haulers (Table 6) and out-of-state receiving facilities (Table 7) accounting for 95 percent of the out-of-state used oil shipments is provided in Appendix C.

Out-of-state facilities can pay more for used oil because they have larger profit margins for every gallon of oil processed compared to California recyclers. This disparity primarily results from the increased facility and operational costs of managing used oil as a hazardous waste within the state. Because out-of-state facilities do not incur these additional costs, they realize substantial profits even when accounting for increased transportation costs from the longer hauling distances. In-state facilities assert that added testing costs, in addition to the facility and operational costs, place them at a disadvantage so they cannot pay the same price as out-of-state recyclers.

Given these pricing disparities, a direct mechanism to increase the amount of closed-loop recycling would be to provide a monetary incentive for independent haulers to transport their used oil to a closed-loop recycler. If the independent haulers are transporting used oil to out-of-state recyclers because they are paid more for the oil, then giving them an incentive to haul the used oil to a closed-loop recycler would allow them to accept a lower payment. By providing this type of incentive to the hauler, a larger volume of used oil would potentially be transported to closed-loop recycling facilities.

## ***Increase Market Demand for the Closed-loop Recycled Product***

### **Increase Public Awareness of Re-refined Lubricant Products**

In the current consumer market, re-refined lube oil products have to compete with virgin products and the consumer rarely has any educated preference. Therefore the cost of the virgin oil product represents a price ceiling that cannot be overcome unless there is educated preference for the recycled product. If a preference can be established, then the recycled product may be able to meet or exceed the price ceiling currently imposed by the market forces for virgin lube oil.

Most consumers have never heard of recycled lube oil or understand the environmental benefits associated with choosing a lube oil product with recycled content. Currently, effective “green” marketing efforts are under way in a range of business sectors that promote products based on their reduced environmental impact. One way to increase the market demand is through improving and promoting education on API-certified lube oil that informs consumers which products are available, and therefore allows them to make “green” choices about their lube oil needs. Without creating a preference for re-refined lube oil, the virgin oil price ceiling will always limit the market potential.

To this end, CIWMB commissioned a recent study to develop marketing strategies that could potentially increase public awareness of re-refined oil, and thus increase the amount of re-refined oil used in private vehicles (CSDH, 2005). The group discovered there is a significant stigma associated with re-refined oil, and recommended that the State require DIFM shops to stock re-refined oils without informing the customers since the notification is not required. They also developed a series of posters aimed at increasing consumer awareness and appealing to the environmental conscious of the general public (*Ibid.*).

### **Mandatory Recycled Content**

Mandated recycled content would create an automatic demand for re-refined lube oil. In this case, the recycled product does not compete with the virgin product until the mandatory recycled content has been achieved. In our early interviews with Evergreen Oil, Gary Colbert informed us that, with the support of his local Assemblyman, he was collaborating with a law firm to draft an assembly bill that will require a minimum re-refined content for lubricants sold within California. As a result of this discussion, we believe that mandating recycled content will increase the

demand for closed-loop recycled products and thus increase the amount of used oil that gets recycled to its “highest and best use.”

There is already some degree of mandated demand operating in the present market. Per Section 10409 of the Public Resources Code, the California requires that all local government agencies purchase certified lubricant with the highest percentage of recycled content, assuming it is available and equivalent in price to a virgin oil product. The federal government has a similar rule outlined in Section 403a of Executive Order 13149 (and originally recommended as a purchasing guideline by the EPA) which states that no federal agency or state or local agency receiving federal funds, shall purchase virgin oil products if re-refined products are reasonably available and they meet the vehicle manufacturers’ specifications. According to the EPA’s website, they recommend a minimum re-refined content of 25 percent.

The mandated demand outlined by the Italian government is considerably more far-reaching. According to DOE, Italy not only mandates that government vehicles use re-refined products, they also require the use of re-refined oils in motor oils (DOE, 2006). The DOE report also states that Italy subsidizes both used oil collectors and re-refiners. In fact, they report that Italy has six re-refiners in operation, all of whom receive funding from Italy’s lube oil sales tax.

Despite the precedent for having a minimum re-refined content, stakeholders responded with strong resistance to a minimum re-refined content. In addition to the bureaucratic difficulties of implementing a minimum content standard, in-state facilities feel that any effort to mandate recycled content would be met with backlash from the major oil companies and that, consequently, the effort would be infeasible. Gary Colbert, Evergreen Oil, has also come to the same conclusion through his attempts to garner support for a mandatory recycled content.

Although State and federal vehicle fleet operators are mandated to use re-refined lube oil in all automotive fleets, a recent survey of California’s fleet operators indicated that many were not purchasing lubricants with re-refined content (CSLB, 2006)--demonstrating the ineffectiveness of mandates that do not also include an enforcement component.

### **Tiered Monetary Incentives**

In lieu of a mandatory recycled content, there are other market-based mechanisms to increase the demand for re-refined oil while still focusing on the recycled content of lubricant products. These steps create an economic preference for re-refined lube oil products over virgin products. For example, offering lubricant blenders and marketers a monetary incentive based on recycled content could lower their total cost of production and increase demand.

This approach is modeled on the tiered benefit management strategy in place in Australia. The \$0.50/ L benefit offered for re-refining far outweighs the \$0.03-0.07/ L benefits provided for diesel production, and RFO production receives no benefit in that system (DEWR, 2007).

While the difference in benefits that Australia offers for re-refined oil and MDO is quite large, it is difficult to know precisely what size rebate California would need to increase demand for recycled lube oil. Regardless of identifying monetary amounts for such a program, at the April 8, 2008, Stakeholder Roundtable, CIWMB staff suggested offering a tiered rebate based on the recycled content.

Another tiered product incentive would be to reduce CIWMB’s fee on lube oil sales by the percent of recycled content. This reduction could be implemented on the whole fee or only on a fraction of the fee, to keep the funds that ensure adequate lube oil collection from being eliminated. In either case, lowering the fee on products with recycled content enables the re-

refined lube oil products to better compete with virgin products at the consumer level. Economic incentives structured in this way are expected to increase consumer demand for re-refined lube oil.

## ***Increase Capacity for Greater Closed-Loop Product Production***

### **Modify Permitting Procedures on New Re-refining Capacity**

The difficulty, time, and cost associated with the permitting process for creating new re-refining capacity within California severely limits the ability to produce greater quantities of re-refined base lube oil. As previously mentioned, the permitting process for Evergreen to expand its Newark re-refining operations took seven years. Additionally, Safety-Kleen cited permitting difficulties as a substantial obstacle for establishing re-refining facilities within California.

Safety-Kleen will be spending approximately \$30 million to expand its re-refining capacity outside of California in order to meet product demand and, as previously noted, Evergreen will also have additional capacity operational this calendar year. Even with this added capacity, only a fraction of the used oil collected in-state can be re-refined through these facilities, and additional re-refining capacity will be necessary to continue increasing closed-loop recycled lube oil production. Therefore, ensuring the necessary capacity to meet California's re-refining needs also requires attention.

Re-refiners have stated that they would be more likely to increase capacity under a streamlined permitting process that not only expedites the expansion and creation of new re-refining facilities within California, but also decreases the overall cost of obtaining a permit. While these are clear advantages for the re-refining facility, the feasibility of an expedited permitting process is beyond our ability to evaluate given the differences in community involvement, population density, environmental setting, etc. Nonetheless, the inability to site and expand closed-loop recycling facilities ultimately may limit the options available to California in order to maximize production of re-refined lube oil.

### **Subsidize API-Certified Base Lube Production**

In addition to recycled base lube oil competing with virgin lube oil, recyclers compete with each other over used oil. Currently, the costs of closed-loop recycling compared with the market price for API-certified base lube oil causes closed-loop recyclers to lose out to recyclers whose products are more profitable, but less environmentally benign and/or sustainable. Enabling these recyclers to better compete for the available used oil will produce greater volumes of closed-loop recycled base oil. The most direct way to so enable closed-loop recyclers is to provide them with a monetary incentive based on the volume of API-certified base lube oil produced from used oil collected in California.

This incentive would also encourage recyclers who do not currently have closed-loop recycling capability, to invest in the needed infrastructure in order to be able to collect on the incentive. It would enable closed-loop recyclers to offer more money to generators or haulers for their used oil resources than recyclers who are not closed-loop recycling. Since California's capacity for closed-loop recycling is significantly less than the potential oil available, this incentive should be made available to closed-loop recycling facilities producing API-certified base lube oil both within and outside California, as long as out-of-state facilities adhere to California's environmental standards for used oil waste characterization criteria and disposal.

Closed-loop recycling facilities outside of California should be viewed as critical partners for reaching the goal of maximizing base lube oil production. Out-of-state recycling facilities do not

have the same environmental standards as in-state facilities but typically have the ability to recycle both at lower operating costs and using more contaminated used oil. To ensure more level-market conditions and to prevent the exporting of pollution, facilities would only be eligible for California incentives if used oil received by the facilities is handled, tested, and treated as it would be when received by a California facility. For example, if used oil received by an out-of-state facility is tested and determined to exceed acceptable contaminant levels for recycling in California, even if it meets the standards within its state, the used oil must be disposed of as hazardous waste instead of recycled and allowed to create an increased level of pollution.

The specific value of this incentive has been difficult to obtain from current stakeholders, although a range between \$0.02-0.05 per quart was discussed, with most estimates at the upper end of that range.

# Recommendations

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Our recommendations are intended to facilitate the closed-loop recycling of used oil back into API-certified base lube oil primarily through market-driven forces in order to require a minimal amount of government intervention, while maintaining California's leadership in environmental responsibility and stewardship. In our deliberations, we considered an array of potential mechanisms that accomplish this by:

- Increasing the volume of used oil collected for recycling
- Increasing the demand for the recycled base lube oil product
- Increasing California's closed-loop recycling production capacity.

We shared these ideas with stakeholders throughout the used oil market system and received valuable feedback about the feasibility, impact, and industry support. It was evident from discussions with both stakeholders and regulators that viable market-based solutions were preferred over regulatory mandates. This feedback ultimately guided the focus of our recommendations. The market for used oil appears to be functioning effectively; therefore we have focused our recommendations on identifying ways to influence market forces to drive the system toward CIWMB goals. The steps below are our conclusions for the best ways to influence the current used oil market toward production of recycled products that improve both the environmental impact and the sustainability of California used oil recycling.

## **Recommended Action 1**

- Implement effective "green" marketing efforts to promote use of recycled API-certified lube oil.

### **Expected Impact:**

- Increase consumer awareness and demand for recycled API-certified lube oil.
- Requires expenditure of funds from fees collected by CIWMB.

## **Recommended Action 2**

- Encourage and support increased curbside used oil collection

### **Expected Impact:**

- Increase volume of used oil collected.
- Requires additional cost/effort for implementation of curbside collection which may require partial funding support from fees collected by CIWMB.

### **Recommended Action 3**

- Based on the volume of API-certified base lube oil produced from used oil collected in California, provide a monetary incentive to recycling facilities producing API-certified base lube oil both within and outside California that maintain California standards for used oil handling, waste classification, and disposal.

#### **Expected Impact:**

- Increase production of API-certified base lube oil from used oil collected in California.
- Requires CIWMB to spend funds from fees collected and administer the documentation and payment of the incentive program.

### **Recommended Action 4:**

- Reduce the recycling component of the fee on lube oil sales, based on the percent of API-certified recycled content. In other words, the greater the percentage of API-certified recycled content, the lower the fee.

#### **Expected Impact:**

- Increased demand for lube oil with recycled content.
- Reduces fee collected for CIWMB recycling efforts.

### **Recommended Action 5:**

- Provide a smaller monetary incentive, relative to the base lube production incentive, to facilities that produce industrial lubricant or MDO from California's used oil, provided they adhere to California's testing and waste management procedures.

#### **Expected Impact:**

- Increase production of industrial lube oil or marine distillate oil from used oil collected in California.
- Requires CIWMB to spend funds from fees collected and administer the documentation and payment of the incentive program.

### **Recommended Action 6**

- Based on which of the above recommendations are adopted, increase the current fee on lube oil sales administered by CIWMB to support the selected recommendations as necessary. We recommend structuring the increase into two components: an increased collection component that would include the CCC incentive plus the cost of additional collection efforts, and an increased recycling component that would include the cost of the recycling incentives.

#### **Expected Impact:**

- Provide needed resources to CIWMB.
- Increase the cost of lube oil to the consumer.

# Abbreviations and Acronyms

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API	American Petroleum Institute
Cal Poly	California Polytechnic State University (San Luis Obispo)
CARB	California Air Resources Board
CCC	Certified Collection Center
CEC	California Energy Commission
CIWMB	California Integrated Waste Management Board
CWMB	California Waste Management Board <sup>§§</sup>
CORE	California Oil Recycling Enhancement Act
DD	Distillation Dehydrator
DEWR	Department of the Environment and Water Resources (Australia)
DIFM	Do-it-For-Me (quick lube shops)
DIY	Do-it-Yourself
D/K	Demmenno/ Kerdoon
DOE	U.S. Department of Energy
DTSC	California Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
GEIR	Groupement Européen de l'Industrie de la Régénération
GHG	Greenhouse Gas
HSC	California Health and Safety Code
ISOCI	Industrial Service Oil Company, Inc.
LCA	Life Cycle Assessment
LLNL	Lawrence Livermore National Laboratory
Mgal	Millions of gallons
MDO	Marine Distillate Oil
PCB	Polychlorinated Biphenyls (organic compound, regulated concentration in used oils)

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<sup>§§</sup> CIWMB was created in 1989 and evolved out of the Solid Waste Management Board. “California Waste Management Board” appears as the organizational listing on early used oil recycling reports.

PRC	California's Public Resources Code
RFO	Recycled Fuel Oil
SFSU	San Francisco State University
TFE	Thin Film Evaporation
VD	Vacuum Distillation

# Glossary of Terms

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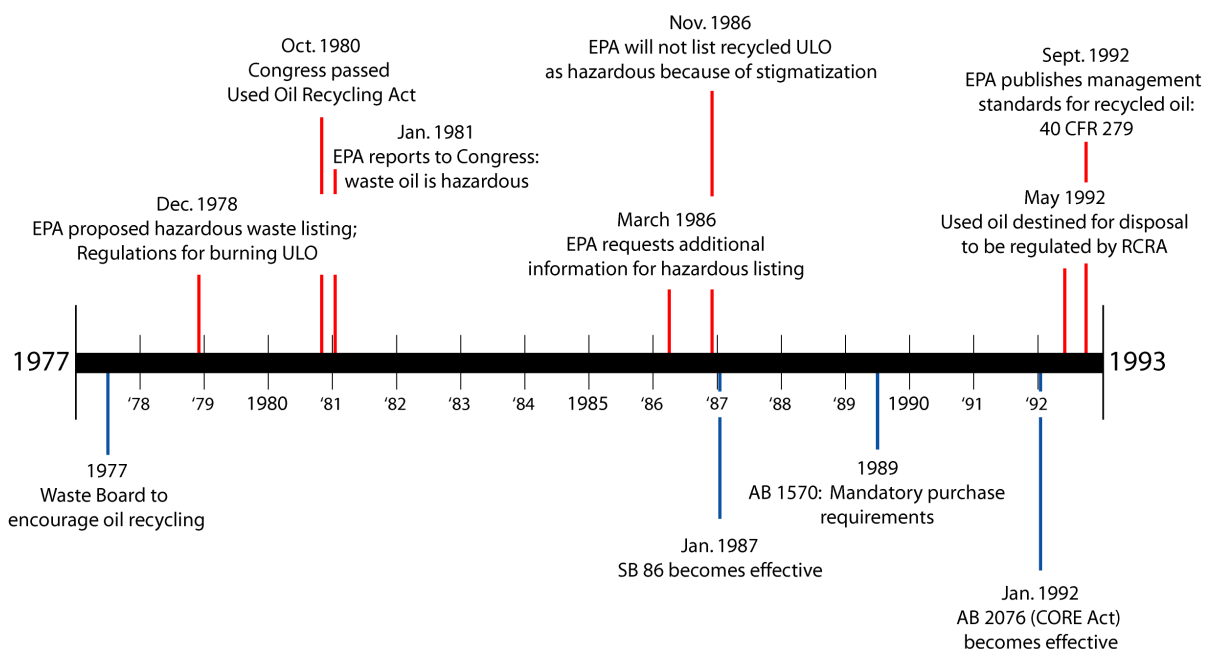
- Base Lube--Oil that is blended with various additives to produce a finished lubricant product; referred to as “Lubricant Base Stock” in other texts (CalEPA, 2004)
- Bunker Fuel--A mixture of residual (heavy) oils blended with a small fraction of distillate fuel; primarily used as fuel in the shipping industry
- Certified Collection Center--Any store registered with CIWMB to receive used oil from the public; CCCs are eligible to receive the current \$0.16/ gallon collection incentive.
- Distillate Fuel--Light to intermediate fraction captured during the distillation phase of refinery operations (CalEPA, 2004)
- Generator--Any individual or group entity that uses lubricating oil.
- Industrial Oil—“ ‘Industrial oil’ includes, but is not limited to, any compressor, turbine, or bearing oil, hydraulic oil, metal-working oil, or refrigeration oil. Industrial oil does not include dielectric fluids.” (Section 48616 of the PRC)
- Lubricating Oil--Heavy distillate fraction from the refining process; Section 48618 of the PRC states: “ ‘Lubricating oil’ includes, but is not limited to, any oil intended for use in an internal combustion engine crankcase, transmission, gearbox, or differential in an automobile, bus, truck, vessel, plane, train, heavy equipment, or other machinery powered by an internal combustion engine.”
- Marine Distillate Oil--Distillate fraction used by the shipping industry; a cleaner fuel relative to bunker fuel; produced from virgin or used oil; Also referred to as “Marine diesel oil”
- Recycled Oil--According to paragraph (3) of subdivision (a) of Section 25250.1 of the HSC, “recycled oil” is any oil produced from used oil by an in-state generator lawfully recycling its oil, by an in-state certified recycling facility, or by an out-of-state facility operating in compliance with federal used oil processing regulations. The product must not have been mixed with other contaminants, must not be regulated federally as a hazardous waste, and must have contaminant concentrations below limits set forth in subparagraph (B) of paragraph (3) of subdivision (a) of Section 25250.1.
- Recycled Fuel Oil--A fuel oil produced with minimal processing of used oil; usually blended and burned for energy recovery, often as bunker fuel; also referred to “Fuel Oil Cutter,” “Reclaimed Oil,” and “Reprocessed Fuel Oil”
- Transfer Facility--A facility certified as a transfer facility per subdivision (a) of Section 25123.3 of the HSC that also meets the qualifications to store materials set forth in that section of code.
- Transporter--Any entity certified to haul used oil in California; may pick up oil from collection centers; also referred to as “Haulers”
- Used Oil--Subdivision (a) of Section 25250.1 of the HSC states that “used oil” refers to any oil, either refined from crude oil or synthetic, that has been contaminated with physical or chemical impurities during use, and is subject to regulation under Part 279 of Title 40 of the Code of Federal Regulations.

# **Appendix A**

## **Regulatory History**

## Brief Regulatory History

An abbreviated history of federal and State used oil management legislation is outlined in Figure 7. Each event in the timeline is clarified in the text below.



**Figure 7. Timeline of key federal and State used oil management legislation.**

## Federal Used Oil Management History

The U.S. Environmental Protection Agency (EPA) first made public its intention to regulate used lubricating oil in 1978 (DOE, 1993). The initial intention was to list waste lubricating, hydraulic, and cutting oil as a hazardous waste, and the EPA proposed regulations for burning used oil for fuel or applying it as a dust suppressant. The Used Oil Recycling Act passed by Congress in October 1980 required the EPA to determine the hazardous status of used oil and outline standards for recycling. Again, the EPA's report to Congress cited the toxicity of used oil as a reason for listing waste oils as hazardous materials. The EPA's position on the hazardous nature of waste oil did not seem to change over the next several years, until March 1986 when the Agency requested additional information to determine the hazardous status of used oil. In November 1986, the EPA decided not to categorize recycled used oil as a hazardous material for fear that doing so would stigmatize oil recycling. The Agency decided in May 1992 to classify used oils destined for disposal as hazardous waste to be regulated according to the Resource Conservation and Recovery Act (RCRA), and in September of that year confirmed the decision not to treat oil destined for recycling as a hazardous waste in the Code of Federal Regulations.

The publication of Title 40 CFR Part 279, established the federal management standards for recycled used oil. Many states have adopted “Part 279” as the regulatory guidelines for used oil in their states.

Since the publication of 40 CFR Part 279, the federal used oil management standards have undergone few revisions.

## ***California’s Used Oil Management History***

California is one of the few states to have adopted more stringent regulations than the Part 279 standards. Per legislation passed in 1977, CIWMB was to use educational programs to promote oil recycling while also providing technical assistance for collection centers. Over the next several years, the number of collection centers grew to a maximum of ~2,500 in 1985. In 1986, California passed SB 86, which made it illegal to dispose of used oil in sewer and drain systems, bodies of water, the landfill, or by burning for fuel. It also defined purity standards for recycled oil and reclassified used oil as a hazardous waste material. In the years immediately following the passage of this legislation, the number of collection centers decreased, with approximately 1,200 estimated by 1988. To encourage use of recycled lubricating oil, AB 1570 was passed in 1989 and required that local and state government agencies use re-refined oil, assuming the cost of the re-refined product was equal to or less than the price of virgin lubricating oil. California’s legislative efforts culminated in the passing of AB 2076, the California Oil Recycling Enhancement (CORE) Act, in 1991 (Public Resources Code (PRC) 48600-48695).

### **The CORE Act**

The CORE Act has two primary goals:

1. To reduce the amount of illegal dumping.
2. To increase reclamation of used oil for the sake of conserving a natural resource and minimizing environmental impacts.

To achieve these objectives, AB 2076 mandated that CIWMB establish and manage the Used Oil Program (UOP). Funding for the program comes from a fee of \$0.16/ gallon of lubricating oil sold in California, levied on the suppliers.

The money would be spent in several ways:

1. Program administration costs.
2. To pay a recycling incentive of \$0.16 per gallon of used lubricating oil brought to a certified collection center;
3. Award and administer a set of grants to promote the expansion of used oil collection services throughout the state; grants apply to education, outreach, and establishing CCCs and curbside collection programs.

The certified collection centers (CCCs) must apply to be included in the program and have to meet certification guidelines defined by CIWMB and enforced by the Department of Toxic Substances Control (DTSC).

## Similarities Between Federal and State Regulations

California's used oil management program, established under the CORE Act, has similar record-keeping criteria as the federal act, but CORE also has stricter regulatory standards than the federal act. Under the CORE Act, California considers all used oil to be a hazardous material until specified contaminants have been removed and the product meets certain composition criteria. This means that collection facilities, haulers, transfer or disposal facilities, and recycling facilities are required to obtain a hazardous waste permit before handling used lubricating oils. Further, relative to the federal codes, the California laws that govern the composition of used oil (Public Resources Code Section 48600-48691 and Health and Safety Code Section 25250) require a used oil product to meet more stringent composition criteria to be considered non-hazardous. These compositional differences are outlined below in Table 3.

**Table 3. Comparison of Federal and State Regulatory limits for key used oil characteristics**

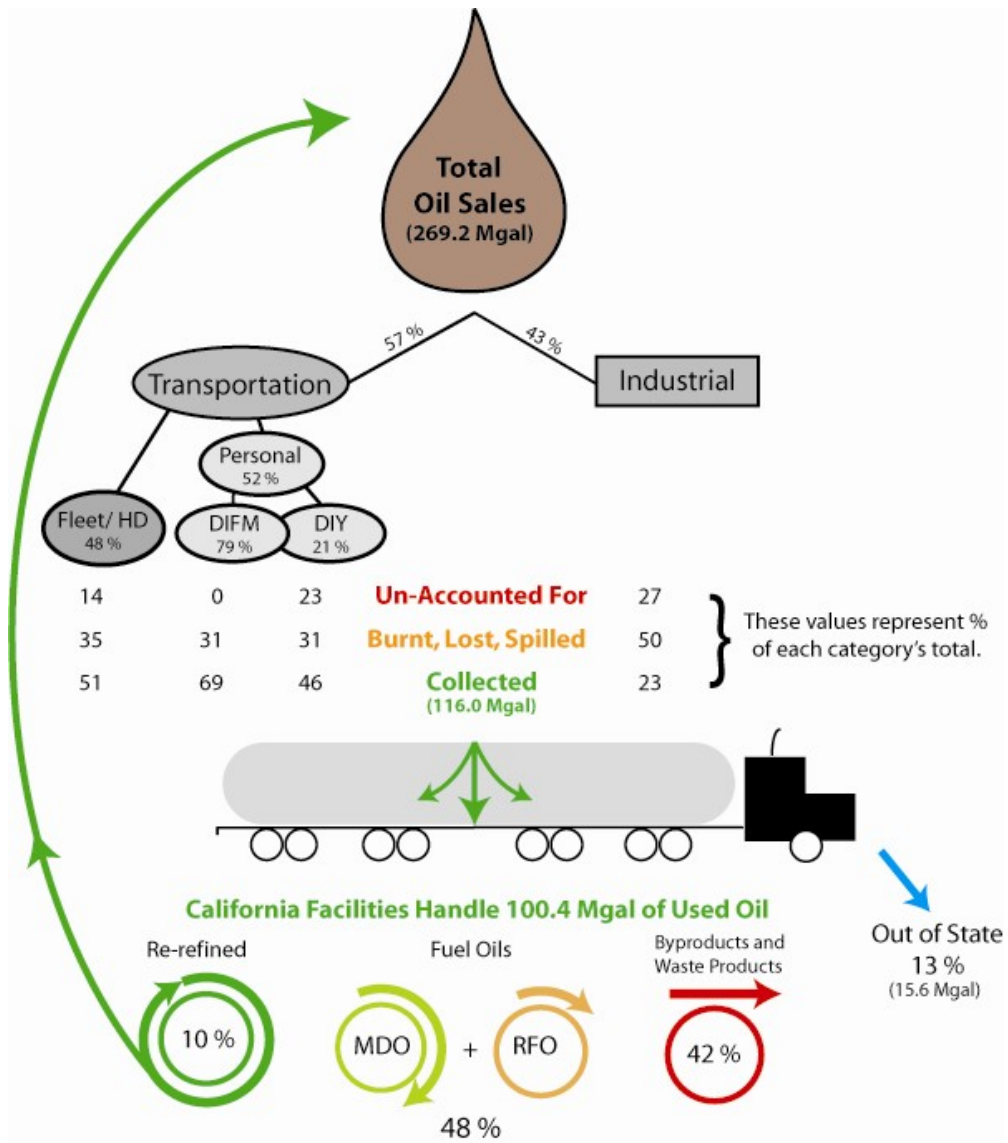
	U.S. EPA limits (ppm)	Cal EPA limits (ppm)
<b>flashpoint</b>	100 F or higher	100 F or higher
<b>Pb</b>	100	50
<b>As</b>	5	5
<b>Cr</b>	10	10
<b>Cd</b>	2	2
<b>Halogens</b>	4000	3000
<b>PCB's</b>	50*	2
<b>Codes/ Regs</b>	Title 40 CFR Part 279	Pub Resources Code Sections 48600-48691
		CA Health & Safety Code Sections 25250 and 25141

\* Burning of used oil containing PCB's is regulated under Title 40, CFR Part 761.20(e)

## **Appendix B**

### **Used Oil Volumes**

The used oil flow diagram shown below was included in the main body of the report. Although several key aspects were noted at that time, it is worth detailing the source for the values presented. The following descriptions are based on notes written by CIWMB and included with the data provided for the flow diagram (CIWMB, 2007).



**Figure 8. Used oil reservoir volumes in California.**

Included in the body of the report as Figure 6 . Data from CIWMB (2007).

## **Volumes Sold**

### **Total Volume**

The total volume sold was not reported. Instead, total motor oil sales and total industrial oil sales were reported (in millions of gallons) and summed to arrive at the 269.2 Mgal estimate.

### **Automotive Sales**

A similar flow diagram was created by staff at CIWMB in 1998. In this schematic, the volume of lubricant sales to Fleet and Heavy Duty (HD) \*\*\* was estimated to be 48 percent of the total automotive sales while personal vehicle sales accounted for 52 percent of the total lubricants sold. This ratio was applied to the 2006 market.

The percentage of oil being managed by DIY oil changers versus DIFM shops was based on estimates found in a 2005 San Francisco State University assessment of DIY activity in California. The researchers found that 23 percent of California vehicle owners have their oil changed by DIY or shade-tree mechanics, with the remaining 77 percent serviced by a professional oil changer. The university assessment's values were adjusted to reflect the national trend of 2.1 percent fewer DIY oil changers (and thus 2.1 percent more DIFM services) to arrive at the values reported in Figure 8.

## **Used Oil Consumption**

### **Burnt, Lost, or Spilled (BLS)**

According to the notes provided with the data, the San Francisco State University (2005) study reported volume losses of 28 percent during automobile use in both the DIY and DIFM sectors. CIWMB staff increased this estimate by 3 percent to account for oil filter losses not accounted for through the reporting mechanisms.

The 35.1 percent BLS estimate for the Fleet/ HD transportation sector was calculated as the average between the adjusted university assessment's value for the private vehicle operations and the commonly accepted value of 40 percent losses during operation of large vehicles and heavy equipment.

Similarly, the 50 percent estimate for volumes lost during operations from the industrial sector is also based on commonly accepted estimates. Note that for industrial oils, some of the oil lost during operation could be described more accurately as "consumed" since many industrial oil applications purposely incorporate oil in the product (Bob Boughton, personal communications, May 8, 2008). Furthermore, the volume presented here includes approximately 15 Mgal of water (*ibid.*).

### **Collected**

The amount of used oil collected from the DIY oil changers is recorded in CIWMB's "Annual Used Oil Block Grant Reports." Furthermore, the data are double-checked against the claims reported to obtain incentive payments. This is the only sector where the reported value of used oil collected is verified against any sort of claim.

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\*\*\* The CIWMB spreadsheet referred to the vehicles in this category as "Heavy Fleet/ Commercial Vehicles." Stakeholder comments indicated that "Fleet/ Heavy Duty" was a better description of the types of vehicles included in this category.

Instead, the amount of DIFM used oil collected is estimated by subtracting the amount of oil lost during operation (BLS) from the estimated total for DIFM oil, and by assuming that no oil is improperly disposed of by DIFM oil changers. This is a justifiable assumption because the industry is heavily regulated and any improper disposal would be noticed by hazardous waste inspectors.

The amount of Fleet/HD oil collected is calculated by applying the 52:48 ratio of Personal-to-Fleet/HD oil sales to the amount of used automotive oil collected. In other words, the estimate reported is 48 percent of the total used oil collected from the automotive sector.

As stated above, this estimate of used oil collected from the industrial sector includes 15Mgal of water (Bob Boughton, personal communications, May 8, 2008). All three used oil recyclers in California de-water the oil. Since the water is removed, one can argue that it should not be included in the total volume of used oil that could be recycled. If this industrial water is removed from the total, then there are only approximately 80-85 Mgal of used oil available for recycling.

### **Unaccounted For**

For all of the lubricant sectors shown in Figure 8, the amount of oil “Unaccounted For” is calculated as the difference between the amount of oil sold to a particular sector minus the volumes lost during operation and collected from that sector. To determine the volume of Heavy Fleet used oil Unaccounted For, take the total volume of used automotive oil and subtract the contributions from the DIY and DIFM sectors.

An additional note provided by CIWMB indicated that the amount of Industrial used oil that is unaccounted for likely is *not* all illegally disposed of. Rather, there is probably a significant amount of industrial oil that is not properly reported, especially oil that is shipped out of state.

## **Recycled Oil Products**

### **In-state Facilities**

Recall that all in-state facilities must report, on a quarterly basis, the volumes of used oil received and the volumes of each product they produce during a given quarter. CIWMB provided a summary of California’s recycled oil products for 2006, listed by facility and amount of product. The state-wide estimates presented in the used oil system diagram are simply the summations of each product category as reported by each facility.

### **Out-of-State Facilities**

Out-of-state facilities are not required to report their volumes on a quarterly basis. The 15.6 Mgal reported in Figure 8 as leaving the state represent the volume of out-of-state used oil shipments as reported by the certified haulers. This volume only accounts for used oil being shipped directly from a generator to an out-of-state facility and does *not* account for oil that goes through a Transfer, Storage, and Disposal Facility before being shipped across state lines.

What we do know about the used oil disposition for California-generated used oil shipped out of state comes from the voluntary reporting of two Oregon facilities: Industrial Oils, Inc., and Oil Re-refining Company (ORRCO). The fate of the used oil received by these two facilities was included in Figure 5.

## **Byproducts and Waste Products**

The estimate presented here is a summary of several categories tracked by the State. Included in this estimate are the categories detailed in Figure 5:

- Asphalt: a useful byproduct of distillation that sequesters the contaminants from the used oil;
- Non-hazardous waste: this includes the water removed during dehydration (“dewatering”); according to the statements by Bob Boughton (personal communications, May 8, 2008), this underestimates the amount of water;
- Hazardous waste.

## **Appendix C**

# **Out-of-State Oil Shipments**

## **Background**

In their response to the preliminary recommendations presented to CIWMB on February 13, 2008, several stakeholders indicated that the amount of used oil shipped out-of-state was inaccurate and was an under-representation. For instance, in his testimony at the meeting, Robert Sulnick (representing Evergreen) indicated that a DTSC document estimated much higher volumes of out-of-state shipments. At that point, CIWMB requested a more detailed review of those shipments.

It became clear the two organizations have different accounting mechanisms for the used oil shipped across state lines. As previously mentioned in Appendix B, CIWMB accounts for used oil shipped directly from generators to out-of-state facilities as reported by the used oil transporters. On the other hand, DTSC maintains a database of shipping and receiving manifests for all the hazardous waste codes as provided by generators, haulers, and receiving facilities.

## **Public Access Request**

To review the manifested volumes, LLNL submitted a Public Access Request to DTSC. The request included a summary of out-of-state shipments for the years 2004-2007 as reported by the generators under three different waste codes: 221 Waste Oil, 222 Oil/Water Separation, and 223 Unspecified Oily Waste. This summary is provided below in Table 4. Note that only years 2004-2006 are shown in the table; not all of the manifests representing 2007 shipments were submitted at the time of the request.

**Table 4. Summary of Out-of-State Shipments by Waste Code for Calendar Years 2004-2006.**

	Waste code		
	221	222	223
2004	23,283,911.75	539,692.03	2,346,980.58
2005	23,489,857.89	243,310.20	4,762,201.25
2006	27,744,855.04	422,617.31	5,523,209.35

As Table 4 clearly shows, the amount of used oil shipped out of state as 221 Waste Oil increased dramatically (by approximately 18 percent) from 2005-2006.

In addition to this summary, a more detailed report of the 221 Waste Oil was provided for the same time period that included an identity of all the generators, haulers, and receiving facilities. With this massive amount of information, it was possible to add all the volumes reported by each individual within a stakeholder category to compare to the summary value (see

Table 5). The comparison showed that the out-of-state receiving facilities are not diligent in their compliance with state regulations to return the receiving manifests to DTSC as they typically have the highest percent of under-reported used oil compared to the summary value.

**Table 5. Comparison of Summary Waste Oil with Volumes Reported by Each Category of Stakeholder.**

<b>Percent Difference from "221" Waste Oil (%)</b>				
	<b>Summary</b>	<b>Generators</b>	<b>Transporter</b>	<b>TSDf</b>
<b>2004</b>	23,283,912	0.09	0.36	5.46
<b>2005</b>	23,489,858	0.33	1.99	4.51
<b>2006</b>	27,744,855	0.24	1.97	1.40

Reviewing the detailed report for each stakeholder category, one can see that a small number of companies account for most of used oil shipped out of state. A listing of the haulers and the receiving facilities that account for 95 percent of the out of state used oil shipments are provided in Table 6 and Table 7, respectively.

**Table 6. Certified used oil haulers accountable for ~95 percent of used oil shipped out of state (OOS)**

TRANSPORTER EPA_ID	FAC_NAME	Percent of Total Shipped OOS				2006 Cumulative Percent
		2004	2005	2006	2007	
	UNION PACIFIC RAILROAD CO	18.2	24.5	<b>19.0</b>	4.5	19.02
	CLEARWATER ENVIRONMENTAL MGMT	16.7	21.0	<b>19.0</b>	0.0	38.03
	CHICO DRAIN OIL SERVICE LLC	12.2	13.9	<b>11.6</b>	19.6	49.64
CAD981459829	ATCHISON TOPEKA & SANTA FE RAILWAY CO	16.5	16.7	<b>10.6</b>	8.0	60.27
AZR000502534	RCM TRANSPORTATION	0.0	0.0	<b>5.0</b>	9.8	65.26
CAD004771606	CALIFORNIA TANK LINES INC	0.0	1.9	<b>5.0</b>	4.5	70.23
	THOMAS J.A. MCCOY TRUCKING CO.	0.0	1.7	<b>3.9</b>	3.6	74.12
CAL000253361	ALL PHASE ENVIRONMENTAL	13.5	0.0	<b>3.7</b>	0.0	77.85
UTD988075669	VALLEY OIL TRANSPORTATION, INC	2.6	3.3	<b>3.3</b>	0.1	81.20
CAD980813950	CRANE'S WASTE OIL INC	1.0	2.3	<b>2.2</b>	0.8	83.40
	FILTER RECYCLING SERVICES INC	0.0	2.2	<b>2.1</b>	0.1	85.52
	FREMOUW ENVIRONMENTAL SERVICES INC	0.0	0.0	<b>1.7</b>	3.8	87.24
NVD118279090	BULK CARRIER SERVICES	0.0	0.1	<b>1.5</b>	0.0	88.70
CAD981694722	TTS ENVIRONMENTAL INC	0.2	0.3	<b>1.3</b>	2.4	90.04
	THERMO FLUIDS INC	0.0	0.0	<b>1.1</b>	0.1	91.10
CAR000148676	BMG OIL SERVICE LLC	0.0	0.3	<b>0.8</b>	0.0	91.94
AZR000503615	TRINITY TRANSPORT LLC (WORLEYS)	0.0	0.0	<b>0.5</b>	5.3	92.48
	CLEAN HARBORS ENVIRONMENTAL SERVICES	0.9	0.3	<b>0.5</b>	2.1	92.99
CAR000162636	ABE ARENS BROTHERS ENVIRONMENTAL INC.	0.0	0.0	<b>0.5</b>	1.9	93.47
CAD981412356	PACIFIC TRANS ENVIRONMENTAL SERVICES INC	0.0	0.0	<b>0.4</b>	0.5	93.90
	PHILIP TRANSPORTATION AND REMEDIATION	0.2	0.1	<b>0.4</b>	0.0	94.32
	EVERGREEN ENVIRONMENTAL SERVICES CARSON	1.5	0.3	<b>0.4</b>	1.0	94.73
ORQ000007781	MATT GARRIS WASTE OIL RECOVERY INC	0.0	0.0	<b>0.4</b>	0.7	95.14
	ARENS ENVIRONMENTAL SVCS, INC.	0.1	0.1	<b>0.4</b>	0.1	95.54

**"Methods:"**

1. Sorted "Transporters" from DTSC alphabetically.
2. Combined the volumes reported by the same company under different EPA ID's
3. Sorted all volumes in descending order according the 2006 values.
4. Calculate what percent of the total volume reported by all the transporters is accounted for by each company.
5. Summed the percentages to identify the companies that account for 95 percent of the used oil:
  - 14 companies account for 90 percent of used oil shipped out of state
  - 24 companies account for 95 percent of used oil shipped out of state

**Table 7. Out-of-State (OOS) receiving facilities accountable for ~95 percent of the used oil shipped out of state**

TSDF_EPA_ID	FAC_NAME	Percent of Total Shipped OOS				2006 Cumulative Percent	Product
		2004	2005	2006	2007		
NVD982358483	CLEARWATER ENVIRONMENTAL MANAGEMENT INC	23.2	23.8	<b>18.9</b>	19.8	18.89	RFO
	THERMO FLUIDS INC	11.3	12.4	<b>17.4</b>	20.7	36.31	RFO, Asphalt
ORD980980775	INDUSTRIAL OIL INC	13.7	13.2	<b>14.0</b>	25.4	50.27	Industrial fuels and lubricants
AZR000030452	RESOURCE RECOVERY TECHNIQUES	11.3	14.1	<b>11.7</b>	0.2	61.93	Primarily handle oily water, which could indicate incorrect codes reported; oily water separated into greywater and "sludge" - greywater used for coolant at power plant/ lawn watering
ORD180761934	CASCADE GENERAL INC	8.2	14.8	<b>6.8</b>	5.4	68.74	According to their website: Shipyard
AZR000033381	MESE OIL INC	1.1	2.8	<b>6.1</b>	0.3	74.79	Product sold as burner fuel for asphalt plants
IDR000201475	COMMERCIAL FUEL RECYCLING LLC	0.0	2.0	<b>4.9</b>	6.1	79.66	According to their website: RFO
TXR000033647	VERTEX ENERGY LP	0.0	0.0	<b>4.1</b>	4.8	83.80	
TXR000050013	COWHOUSE PARTNERS USED OIL	1.1	3.0	<b>3.7</b>	0.2	87.50	
UTD070534623	GOLDEN EAGLE OIL REFINERY INC	3.0	3.0	<b>2.9</b>	3.2	90.35	Dewater the used oil - product sold for energy recovery to asphalt plants, primarily, but also to 1 incinerator
AZR000500587	TRANSTITAN LLC	0.0	1.0	<b>1.9</b>	0.1	92.26	
ORQ000007781	MATT GARRIS WASTE OIL RECOVERY INC	0.0	0.1	<b>1.2</b>	0.8	93.45	Dewater and filter - product sold for energy recovery to asphalt plants and industrial boil, and for heat recovery
	CLEAN HARBORS PPM LLC	3.4	1.7	<b>0.9</b>	5.3	94.34	Five (5) facilities: 3 are incinerators, 1 is a PCP facility, 1 is a TSDF.
OHD986977304	HEARTLAND PETROLEUM LLC	0.0	0.3	<b>0.8</b>	0.0	95.17	

**"Methods:"**

1. Sorted "Transporters" from DTSC alphabetically.
2. Combined the volumes reported by the same company under different EPA ID's
3. Sorted all volumes in descending order according the 2006 values.
4. Calculate what percent of the total volume reported by all the transporters is accounted for by each company.
5. Summed the percentages to identify the companies that account for 85 percent of the used oil:
  - 10 companies account for 90 percent of CA used oil received out of state
  - 14 companies account for 95 percent of CA used oil received out of state

## **Appendix D**

### **Curbside Collection Data**

A critical component of the recommendations was to continue expanding collection efforts. In the discussion surrounding how to increase the amount of used oil collected, we recommended increasing the number of curbside collection programs. The basis for this recommendation came from analyzing the used oil incentive claims submitted to CIWMB for fiscal year 2005/2006. Below is a listing of all the curbside collection programs according to the annual used oil block grant report; this information has been checked against claims data (CIWMB, 2008).

**Table 8. Summary of curbside collection programs within California.**

Data provided by CIWMB.

County	Grantee (City/County)	Curbside DIY Oil Gallons Collected, FY 2005-2006
Alameda	Alameda	1,508
	Alameda County	6,102
	Dublin	1,288
	Fremont	22,516
	Hayward	12,336
	Livermore	3,700
	Newark	3,720
	Oakland	12,817
	San Leandro	3,859
	Union City	5,687
Calaveras	Calaveras County	110
Contra Costa	Antioch	7,300
	Contra Costa County	619
	Martinez	3,866
	Pleasant Hill	1,893
El Dorado	El Dorado County	4,150
Fresno	Fresno	13,830
	Fresno County	8,441
Kern	Bakersfield	5,427
Los Angeles	Baldwin Park	840
	Claremont	350
	Compton	724
	Diamond Bar	850
	Glendale	2185
	Inglewood	21
	La Verne	825
	Lancaster	736
	Lawndale	76
	Long Beach	11,004
	Lynwood	191
	Monrovia	574
	Norwalk	1,629
	Palmdale	1,352
	Paramount	372
	Pasadena	1,716
	Rancho Palos Verdes	1,504
	Rolling Hills Estates	572
	San Dimas	835
	Santa Clarita	1,572
Mendocino	Point Arena	1,930
Merced	Merced County	4,417
Monterey	Monterey County	21,481
Napa	Napa	952
	Napa County	5,200
Nevada	Nevada County	4,180

County	Grantee (City/County)	Curbside DIY Oil Gallons Collected, FY 2005-2006
Orange	Buena Park	641
	Costa Mesa	349
	Garden Grove	2,495
	Huntington Beach	1,394
	Laguna Beach	1,004
	Laguna Woods	28
	Orange	2,413
	Placentia	480
	Santa Ana	11,036
Riverside	Coachella Valley Association of Governments	194
	Palm Desert	128
	Riverside	699
	Riverside County	704
	Western Riverside Council of Governments	2,550
Sacramento	Citrus Heights	8,085
	Elk Grove	5,544
	Folsom	3,525
	Rancho Cordova	6,129
	Sacramento	4,990
	Sacramento County	59,093
San Benito	San Benito County	1,900
San Bernardino	Chino	141
	Chino Hills	3,136
	Fontana	3,304
	San Bernardino	338
	San Bernardino County	35
	Upland	48
	Victorville	1,005
San Diego	Carlsbad	206
	Chula Vista	2,440
	El Cajon	1,049
	Encinitas	59
	Lemon Grove	221
	San Diego	286
	San Diego County	3,310
San Francisco	San Francisco City & County	2,170
San Joaquin	Manteca	16,130
	San Joaquin County	8,775
San Luis Obispo	San Luis Obispo County	28,100
San Mateo	East Palo Alto	700
	San Mateo County	49,520
Santa Barbara	Santa Barbara County	389
Santa Clara	Santa Clara County	291,797
Santa Cruz	Santa Cruz County	16,228
	Watsonville	12,520
Solano	Benicia	2,499
	Fairfield	9,167
	Suisun City	1,819
	Vacaville	5,198
	Vallejo	11,631
Sonoma	Sonoma County	22,894
Stanislaus	Ceres	7,425
	Modesto	2,416
	Stanislaus County	4,442
Yolo	West Sacramento	4,776
	Woodland	215
<b>TOTAL</b>		<b>813,026</b>

## **Appendix E**

# **Stakeholder Roundtable Meeting Participants and Agenda**

The following table lists the representatives of the organizations present at the April 8, 2008, Stakeholder Roundtable meeting sponsored by CIWMB.

**Table 9. Participants, by Organization, in the Stakeholder Roundtable Meeting.**

<b>Organizations</b>	<b>Representatives</b>
Arens Environmental Services, Inc.	Tom Arens
	D. Davison-Arens
Assemblyman Torrico's Office	Ryan Spencer
Bayside Oil Inc.	Larisha Garcia
	Kim Glenn
California Air Resources Board	Glenn Gallagher
Chico Drain Oil	Michael Chiotti
CIWMB	Fernando Berton
	Dawn Gordon
	Steve Lambert
	Howard Levenson
	Jeffrey Lin
	Chris Peck
	Brenda Smyth
	Bert Wenzel
	Shirley Willd-Wagner
Clearwater Environmental Management, Inc.	Bryan Fabian
DeMenno/ Kerdoon	Jim Ennis
Evergreen Oil	Robert Sulnick
Fremouw Environmental Services	Ted Fremouw
	Marty Mosley
Independent Waste Oil Collectors and Transporters	Phil Vermeulen
LLNL	Mackenzie Johnson
	Adam Love
Mattos and Associates	Denise Duncan
	Deborah Mattos
North American Lubricants	Kyle Read
Oil Changer, Inc.	John Denholm
Oil Re-refining Company (ORRCo)	Bill Briggs
Paul Hastings, LLP	Bob Hoffman
	Matthew Sanders
	Peter Weiner
Ramos Environmental Services	Kyle Ramos
	John Villanueva
Regional Council of Rural Counties	Stacey Miner
Safety-Kleen	Mark Phariss
	Cristina Rose
	Bill Ross
Sector Strategies	Chuck Helget
ThermoFluids, Inc.	Roy Schumacher
TTS Environmental	Linda Fitzgerald
	Bob Williams

The meeting progressed according to the agenda presented in Figure 9 below. The agenda was developed by both CIWMB and LLNL.



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### Stakeholder Roundtable

A discussion regarding Lawrence Livermore National Laboratory study  
*Improving Used Oil Recycling in California*

**April 8, 2008**

**10 am to 3 pm or until complete**

Joe Serna Jr., CalEPA Building  
1001 I Street, Byron Sher Auditorium  
Integrated Waste Management Board  
Sacramento, CA 95814

### AGENDA

- I. Opening Remarks and Introduction
- II. LLNL brief discussion on modifications based on feedback to date
- III. Is the Market Demand-Limited for Rerefined Product?
  - a. If yes, recommendations for increasing demand?
  - b. If no, what other market drivers could be adjusted to encourage re-refining?
- IV. Is California Capacity Limited for Increased Rerefining?
  - a. Obstacles to increasing capacity
  - b. Likelihood of increasing capacity
- V. Ensuring Pollution Control
  - a. Is current environmental accountability adequate?
  - b. Possible ways to improve accountability for out-of-state hauling
- VI. Lunch Break
- VII. Impact of CA Hazardous Waste Designation
  - a. Advantages and disadvantages?
  - b. Impact/feasibility of hazardous material designation?
- VIII. Role of Haulers/Collection Centers
  - a. Incentive/Market Influences
  - b. Sorting
- IX. Final Comments

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**Figure 9. Agenda for Stakeholder Roundtable meeting held April 8, 2008.**

## **Appendix F**

### **Responses to Stakeholder Input**

Stakeholders have expressed concerns and provided various perspectives on aspects of this report based on our Preliminary Report and based on the April 8, 2008, Stakeholder Meeting. This appendix addresses specific points of concern about some of the larger assumptions, issues, and analysis.

Robert H. Sulnick

Representing Evergreen Oil, Inc.

April 10, 2008

**Comment 1: Permitting.** It is Evergreen's position that a recommendation by your report that the permitting process be streamlined, would considerably aid the process for establishing more re-refining in California. We believe that such a recommendation is well supported by both the strategic (peaked production of a non-renewable resource), and environmental benefits (conservation and reduction in greenhouse gas emissions) of conserving oil which can, in a closed-loop cycle be "continuously" reused.

***Author's Response:** The feasibility and appropriateness of an expedited permitting process under all circumstances is beyond our ability to evaluate within the scope of this effort given the differences in community involvement, population density, environmental setting, etc. Nonetheless, the report acknowledges that the restricted ability to site and expand closed-loop recycling facilities ultimately may limit the options available to California in order to maximize production of re-refined lube oil.*

**Comment 2: Public education.** Ultimately, the development of a large-scale market for re-refined oil rests with consumer demand. Presently, the sale of re-refined oil in California is limited to the independent lube and government markets. It will take strong consumer demand to finally establish re-refined motor oil as an acceptable everyday product.

In our view, your report should recommend to CIWMB that it undertake sustained public education and advertising regarding the quality (equivalent of virgin, not void auto manufacturers warranties), and the environmental and strategic benefits (conservation, pollution and greenhouse gas reduction) of re-refining used oil as opposed to burning it for fuel. (While fossil fuels will obviously continue to be used for fuel, those that can be closed-looped recycled have, in a world of >\$100 per barrel, oil, become too valuable to burn).

In this regard, the suggestion made at the meeting that incentives go to the end product is premature. It makes no sense to incentivize a product before creating a market for that product.

***Author's Response:** We agree that public education about the benefits of recycled lube oil is needed to help create demand and it is one of our recommendations in the report. We also see an incentive on the product as another valuable mechanism to increase demand and it is one of our recommendations in the report. We view an incentive of the product as part of the overall strategy, including education, to increase consumer demand.*

**Comment 3: Out of-state testing.** The discussion of out-of-state markets must be placed in the context of California promoting the re-refining of California's used oil in California irrespective of out-of-state markets. Currently, out-of-state facilities pay as much as \$0.90 for a gallon of used oil. California recyclers pay \$0.25-\$0.45 (Evergreen); \$0.25-\$0.70 (DK) for the same product. This disparity, in large part, is based on the fact that California facilities have to bear the costs of testing used oil to California statutory standards (PCBs at a concentration of 5 ppm, or greater; a flash point above 100 degrees Fahrenheit; or a concentration total halogens of 1000 ppm or less). In order to ensure that the 27-35 million gallons currently going out of state remain in California, this "economic playing field" has to be leveled. In our view, your report should recommend that all out-of-state shipments of used oil be tested in California prior to shipment. This, in turn, will necessarily cause out-of-state facilities to lower the amounts paid for the oil, making it cheaper for independent haulers to take their oil to California facilities.

***Author's Response:** Given the potential for capacity limitations, we view out-of-state facilities as potentially important partners in enabling the maximum amount of used oil to be closed-loop recycled to its "highest and best use". We strongly believe that out-of-state facilities which want to receive an incentive from California for recycling used oil collected in California need to match California standards for used oil, handling, testing, and disposal. This stipulation ensures more level market conditions and prevents the exporting of pollution. Requiring testing of shipments prior to leaving the state places a financial burden on independent haulers that further degrades their market position and ability to get a competitive price for the oil being hauled. The advantage of testing shipments prior to leaving the state is not clear if the out-of-state facility receiving the shipment follows the same testing, handling, and disposal procedures as California facilities. We do acknowledge that testing out-of-state shipments prior to leaving the state, if those shipments would be delivered to a facility that does not follow the same testing, handling, and disposal procedures as California facilities, would assure used oil with contaminant levels that exceed acceptable levels for recycling in California are not being recycled out of state, and thus would assure that California is not exporting pollution related to used oil.*

**Comment 4: Hazardous waste designation.** It was suggested at the meeting that California should de-regulate used oil. (Your preliminary Power Point made the same suggestion). Lowering California environmental standards is not the way to promote the highest and best use of the resource.

First of all, removing the hazardous waste designation is not politically viable. It would take an act of the Legislature supported by the Governor, which is not going to happen.

Second, removal of the hazardous waste designation would ensure more used oil going out of state, which is not conducive to creating more product for more re-refining in California.

Third, used oil is literally a hazardous waste. It contains phosphates, sulfur, and heavy metals, including zinc, lead, copper, benzene and cadmium. Indeed, a report published in the 2nd issue of Volume 38 of Environmental Science & Technology concludes that the total emission of heavy metals from used oil fuel in 2002 was potentially on the same scale as emissions from all of California's large stationary pollution sources combined. The classification therefore should not be removed. Calling it something it isn't does not make good public policy.

The human health impacts of these airborne pollutants can cause damage to the liver, brain, immune system, and reproductive system and can cause cancer. Once released into the environment, the contaminants tend to build up in soils where they are absorbed by plants and animals and ultimately pass to humans through the food chain. Indeed, the Science & Technology study concludes that the toxicity potential of untreated oil is five times greater for humans and 150 times greater for terrestrial ecosystems than re-refining.

Used oil in aquatic and marine environments has long been understood to pose significant damage to those ecosystems. It is estimated in California alone that 20 million gallons of used oil are dumped into the environment by Do It Yourself (DIY) and illegal dumpers, finding its way into the ocean, rivers, streams, wetlands, and underground aquifers where it contaminates marine and aquatic ecosystems and passes to humans through the consumption of fish and sea food.

Fourth, California is renowned as being the nation's environmental leader. This includes having the nation's strictest air pollution and used oil testing standards, along with classifying used oil as a hazardous waste. Rather than California being regressive, those states that do not classify oil as a hazardous waste should be encouraged to do so.

**Author's Response:** *We received strong feedback from stakeholders that the environmental protection benefits from the hazardous waste designation exceed the associated costs and handling restrictions. We recognize the importance of maintaining California's leadership in environmental responsibility and stewardship. No change is recommended.*

**Comment 5: Role of haulers/collection centers and incentives.** Shifting the current incentive from Certified Collection Centers (CCC's) to transporters will not achieve the goal of causing more oil to be re-refined in California.

CCCs, over the life of the program, have become institutionalized to collecting used oil. They now need to be incentivized to ensure that their used oil is, as a first priority, sent to an in-state re-refiner; and as a second priority to an in-state refiner. This approach, coupled with having California recyclers verify receipt of the loads as a condition prerequisite to receiving the incentive payment, along with ensuring that out-of-state loads have to meet California testing requirements, will incentivize both the highest and best and better use of California used oil.

Transporters, unlike CCCs, cannot be institutionalized. They are mobile and necessarily have to follow the money to sustain themselves. Currently, they can be paid at both ends of their routes (\$25-\$45 from generators, between \$0.45- \$0.90 per gallon from out-of-state destinations). Any incentive from CIWMB, as long as out-of state facilities do not have to meet California standards, is not enough money to disrupt this established business practice. Out-of-state facilities will simply raise the cost of their payments to continue attracting California used oil. Moreover, if California's goal is to ensure that more used oil is re-refined in California, lesser incentives for oil re-refined (and refined) out of state should be established.

Incentives are politically realistic and effective. The Used Oil Program has already established the effectiveness of incentives in establishing over 200 CCCs throughout the state.

Evergreen Oil believes that a tiered approach to incentives should become part of the Used Oil Program. This not only identifies re-refined oil as the highest and best use of the resource, it both acknowledges the importance of refined diesel oil, with fewer toxic metals and a sulfur content less than half adopted by the California Air Resources Board (CARB), while omitting incentive payments for untested and untreated oil. In this regard it is important to acknowledge that current California policy pays financial incentives for untested, untreated, used oil shipped directly out of state for burning.

As an aside, a tiered incentive approach has proven political support. It passed out of the Assembly with bi-partisan support and is currently in the Senate Appropriations Committee. It is supported by business and the environmental community including, but not limited to, Californians Against Waste, the Sierra Club, DeMenno/Kerdoon, SafetyKleen, California Resource Recovery Association, California Independent Oil Marketers Association, Coast Oil Company, Ramos Environmental Services, FRS

Environmental, Inc., Carrs Waste Oil Service, RCA Oil Recovery, Black Star Oil Co., Jim Knight Drain Oil, and Compliance Environmental Services. Moreover, we have received notification from the Western States Petroleum Association (WSPA) that it has adopted a neutral position on this issue.

Evergreen's recommendation is that CIWMB should give the highest possible financial incentive for re-refining oil and a lesser incentive for refined MDO. Simply put, the more incentive money paid for in-state re-refined oil, the more used oil will be re-refined.

**Author's Response:** *We received strong feedback for allowing CCCs to keep their current incentive and recognize the importance of their role in the used oil system. Our directive from CIWMB did not stipulate that the goal was to optimize used oil re-refining in California, only that we were to optimize that the used oil collected in California was re-refined. Although our task was specifically to recommend improvements to optimize the production of re-refined base lube oil, we have gone outside of our specific tasking to recommend a two-tiered incentive system in order to acknowledge the significant environmental advantage of industrial lube oil and MDO production over RFO.*

*We strongly believe that out-of-state facilities which want to receive an incentive from California for recycling used oil collected in California need to match California standards for used oil, handling, testing, and disposal. This stipulation ensures more level market conditions and prevents the exporting of pollution.*

*The advantage of testing shipments prior to leaving the state is not clear if the out-of-state facility receiving the shipment follows the same testing, handling, and disposal procedures as California facilities. We do acknowledge that testing out-of-state shipments prior to leaving the state that are going to out-of-state facilities that do not follow the same testing, handling, and disposal procedures as California facilities would assure used oil with contaminant levels that exceed acceptable levels for recycling in California are not being recycled out of state and resulting in a net exportation of pollution.*

**Final comments.** To be effective, your report has to acknowledge the science-based definition of re-refined oil established by the American Petroleum Institute (API) and the Western States Petroleum Association (WPA). Absent this, re-refining will remain a confusing political "term of art" with companies making claims that they re-refine used oil when in fact they do not. That definition is:

"Re-refined oil" means a lubricant base stock or base oil which has been derived from used oil and:

- a. Has been processed using a series of mechanical and/or chemical methods such as, but not limited to, vacuum distillation, followed by solvent refining, and or hydrotreating;
- b. Is capable of meeting the Physical and Compositional Properties, in addition to the Contaminants and Toxicological Properties, as defined under ASTM D6074; and
- c. Is such that processing has returned the material to a quality level suitable for use in a finished lubricant.

California currently exports pollution to neighboring states. One area of the used oil program which the report fails to analyze is the current practice of California exporting pollution through its used oil program. Under current conditions all untested and untreated loads of used oil transported out of state are burned, releasing air pollution which, by law, cannot be released in California. This practice can and should be stopped by instituting the kind of testing program outlined above.

**Author's Response:** *We believe that in order for automobile lube oil to be closed-loop recycled to its "highest and best use" the resulting product must be API-certified, demonstrating that it has retained the quality and value of the original material. We believe strongly that California should not define a process that results in the categorization of "highest and best use" since that would stifle the ability for advancements in technological solutions that may result in more efficient processes that achieve the same quality product. We believe that API is better suited to judge the quality of lube oil products resulting from new treatment technologies and that California should support any product deemed API-certified as "highest and best use".*

*We strongly believe that out-of-state facilities which want to receive an incentive from California for recycling used oil collected in California need to match California standards for used oil, handling, testing, and disposal. This stipulation ensures more level market conditions and prevents the exportation of pollution.*

*The advantage of testing shipments prior to leaving the state is not clear if the out-of-state facility receiving the shipment follows the same testing, handling, and disposal procedures as California. We do acknowledge that testing out-of-state shipments prior to leaving the state, if those shipments would be delivered to a facility that does not follow the same testing, handling, and disposal procedures as California facilities, would assure used oil with contaminant levels that exceed acceptable levels for recycling in California are not being recycled out of state, and thus would assure that California is not exporting pollution related to used oil.*

Robert P. Hoffman and Peter H. Weiner,

Paul, Hastings, Janofsky & Walker LLP

Representing Demenno/Kerdoon

April 25, 2008

**Comment 1: The Final Report must acknowledge the importance and benefits of marine diesel oil (“MDO”)**

***Author’s Response:** The report acknowledges MDO is an important product resulting from the recycling of used oil. It has an important role in the fuel marketplace. MDO has been acknowledged as having the equivalent environmental impact to re-refined lube oil when considering contaminant emissions alone.*

**Comment 2: Report Premise**

One of the basic premises underlying your February 2008 PowerPoint presentation is that re-refining (which the presentation defines as the process by which used oil is processed into base lubricating oil (“lube oil”)) is environmentally superior to turning used oil into MDO. This is not accurate and will cause your report to be fundamentally flawed.

***Author’s Response:** MDO has been acknowledged as having the equivalent environmental impact to re-refined lube oil when considering contaminant emissions alone. In our evaluation of the “highest and best use” of recycled oil, products were evaluated on environmental impact in terms of amount of contaminant released, but also on the sustainability of the recycling process in terms of closed-loop vs. single-use recycling (as defined in the report) and if the process is downcycling--resulting in a product with a value/quality below the original material. Based on all these criteria, recycling to base lube oil was evaluated as the “highest and best use.”*

**Comment 3: Closed Loop Recycling**

As an initial matter, underlying this faulty premise is another one: that re-refining is truly “closed-loop,” i.e., that used oil can be re-refined over and over again without any loss to the system. We understand that this term was used by CIWMB staff in providing direction to you in their revision to your Statement of Work. However, re-refining is not a “closed-loop” process; it involves many different players and many different points at which used oil or re-refined lube oil is lost to the system. Indeed, your own February 2008 PowerPoint presentation recognizes this in Slide 8 by stating that “closed-loop recycling” involves only 75 percent recovery. Even if no oil were lost, the system is not the “closed-loop” involved in manufacturing processes, but rather a recycling process. This must be clarified in the Final Report so that CIWMB is informed by the report, not misled by it.

***Author’s Response:** We have clearly stated in discussing recycling to base lube oil that the process is not 100 percent closed-loop. For the purposes of the report, we have explicitly defined closed-loop recycling in the main text as a “Process where the quality of the recycled product equals or exceeds the quality of*

*the original material and can itself be recycled through the same processes in a repeatable cycle”. This clarification should avoid any confusion.*

**Comment 4: When market dynamics and environmental factors are taken into account, MDO production is preferable to re-refining.**

Even if re-refining was entirely “closed-loop,” it would fail to account for the market dynamics and environmental impacts and costs of re-refining and MDO production in California. When these factors are appropriately considered, MDO production clearly is environmentally superior to and more resource conservative than re-refining.

In 2005, California produced roughly 515 million gallons of lube oil. Of this amount, 502.28 million gallons was “virgin” lube oil (lube oil derived directly from crude oil) and 12.26 million gallons was re-refined from used oil. However, in the same year, only 276 million gallons of lube oil—just over half of the amount produced—was sold in California. The excess production was shipped out of state for sale and use elsewhere.

These statistics show that the supply of lube oil in California greatly exceeds the demand. As long as this imbalance continues (a likely prospect given that there currently is roughly twice as much supply as demand), there is no meaningful market for re-refined lubricating oil and the market will be unable to accommodate large additional quantities of lube oil. If the State nonetheless encourages re-refining in California through an incentive program, production of lube oil from re-refined used oil likely will displace some production of lube oil from virgin crude oil. See Bob Boughton & Arpad Horvath, Environmental Assessment of Used Oil Management Methods, 38 Env'tl. Science & Techn. 353, 354 (2004) (“Re-refining results in recovery of a high-purity lubricating base oil which displaces virgin lube base oil.”). Such a shift would be energy inefficient and environmentally regressive because it takes substantially more energy to produce lube oil from used oil than from virgin crude oil, and because virgin lube oil, which is derived from crude oil with little processing, would in turn be converted into fuel oil to satisfy the MDO market. This is environmental stewardship turned on its head and is not a good use of our natural resources.

CIWMB, and California generally, should avoid such environmentally regressive consequences by encouraging the production of MDO from used oil, for the following reasons. First, MDO production involves distillation which yields a higher-quality, lower-polluting fuel than recycling without distillation. Currently, the recycling incentive is paid for unprocessed fuel oil cutter stock (“FOC,” also known as “RFO”). MDO indisputably is a better product than FOC, and is, by its own right, a highly valuable form of recycled oil. Second, incentivizing MDO would save energy, not only for the reasons discussed above—it would avoid displacing lube oil derived from crude oil with more energy-costly re-refined lube oil, and it would discourage any incentive to turn virgin lube oil into fuel oil—but also for a more basic reason: it takes less energy to convert used oil into MDO than to re-refine used oil into lube oil. Third, unlike the market for lube oil, the demand for environmentally preferred low sulfur MDO in California is greater than its supply. Finally, the reduction of impacts obtained with re-refining and MDO production, compared to the impacts of FOC, are almost identical. See Boughton & Horvath, 353 Env'tl. Science & Techn. at 357 table 5.

**Author’s Response:** *Our analysis of the used oil market is not limited to California’s supply and demand alone, since the market reaches nationally and internationally. If California’s market for lube oil is saturated, we received strong feedback from stakeholders that there is more than adequate demand for lube oil outside of California. Our research has not located any data that would support the claim that, based on equivalent life-cycle analyses, “it takes substantially more energy to produce lube oil from used*

oil than from virgin crude oil.” In fact, in Chapter 7 of its “Used Oil Re-refining Study to Address Energy Policy Act of 2005 section 1838,” DOE summarized several previous research efforts into the benefits of re-refining. The analysis of this body of earlier research “supports re-refining as the best solution from both energy resource preservation and environmental conservation perspectives.” Furthermore, the American Petroleum Institute states that it takes 50-85 percent less energy to produce a lubricant through re-refining used oil than to produce that same volume by refining virgin crude.

#### **Comment 5: Report Premise**

In light of this information, the Final Report should clarify that despite CIWMB’s March 21, 2007, “Summary for Direction on Work,” re-refining is not necessarily the “highest and best” use for used oil. Lawrence Livermore National Laboratory (“LLNL”), as CIWMB’s independent scientific adviser, should evaluate and refute or qualify that statement. Such evaluation must account for, among other things, the fact that re-refining is not “closed-loop,” the market dynamics of re-refining and MDO production, and the environmental costs associated with each process. LLNL cannot produce an accurate report if it relies on incorrect premises and incomplete information.

***Author’s Response:** MDO has been acknowledged as having the equivalent environmental impact to re-refined lube oil when considering contaminant emissions alone. In our evaluation of the “highest and best use” of recycled oil, products were evaluated on environmental impact in terms of amount of contaminant released, but also on the sustainability of the recycling process in terms of closed loop vs. single-use recycling (as defined in the report) and if the process is downcycling--resulting in a product with a value/quality below the original material. Based on all these criteria, recycling to base lube oil was evaluated as the “highest and best use”.*

#### **Comment 6: The Final Report should recommend, and CIWMB should adopt, a phased-in, two-tiered incentive system.**

Regardless of whether LLNL and CIWMB adhere to the position that re-refining represents the “highest and best” use for used oil, the Final Report must recognize that production of MDO is a crucial part of used oil recycling in California.

Toward this end, the Final Report should assign at least the same value to MDO as it does to re-refining, and it should discourage the production of Fuel Oil Cutter stock. Incentives to encourage re-refining and MDO production should follow the same scheme. The report should not favor one company over another, nor should it encourage the processing of California’s used oil by out-of-state refiners who do not comply with California’s strict environmental standards.

***Author’s Response:** Although our task was specifically to recommend improvements to optimize the production of re-refined base lube oil, we have gone outside of our specific tasking to recommend a two-tiered incentive system in order to acknowledge the significant environmental advantage of industrial lube oil and MDO production over RFO. Based on the assessment of re-refined lube oil as the “highest and best use”, we cannot suggest that they have equivalent incentives if we are tasked with optimization of the production of the product that is the “highest and best use.”*

#### **Comment 7: Downcycling**

Along the same lines, the Final Report must eliminate any reference to MDO production as “downcycling.” The February 2008 Power Point presentation, for example, divided used oil recycling into “closed-loop recycling” (good) and everything else as “downcycling” (bad). It may be appropriate to use the term “downcycling” to refer to Fuel Oil Cutter stock production, but that term must not be used to refer to MDO production, which is a highly valuable form of used oil recycling. We understand that CIWMB, in its March 21, 2007, “Summary for Direction on Work,” used the term “downcycling” to refer to every process other than re-refining, but it is incumbent upon LLNL to explain to CIWMB why this term, at least as applied to MDO production, is pejorative and incorrect.

**Author’s Response:** *We do not assess any of the products from recycling as “good” or “bad,” but instead accurately determine the characteristics of the recycling and product. On page 4 of the main text, we explicitly define downcycling as a “[p]rocess where the quality of the recycled product is less than the quality of the original material.” It is not a pejorative term or incorrect when applied using this definition, but reflects the fact that MDO has reduced quality compared to the original material.*

#### **Comment 8: Incentive for D/K to Re-refine Used Oil**

During the April 8, 2008, meeting, you asked how large the incentive would have to be to encourage D/K to enter the re-refining business. We believe the incentive structure in AB 1195 would be sufficient to incentivize the production of refined oil at D/K.

**Author’s Response:** *Thank you for your economic analysis, we have incorporated this estimate into our main text.*

#### **Comment 9: Emphasizing MDO production is consistent with CIWMB’s Strategic Directives.**

The first of CIWMB’s unanimously adopted Strategic Directives states that the purpose of CIWMB is to, among other things, “recover resources and direct them to their highest and best use, in accordance with the [Integrated Waste Management Act’s] waste management hierarchy (Public Resources Code section 40051).” See <http://www.ciwmb.ca.gov/BoardInfo/StrategicPlan/#Purpose>.

Section 40051, in turn, provides that, “[i]n implementing this division, the board and local agencies shall do both of the following:

- a. Promote the following waste management practices in order of priority:
  1. Source reduction.
  2. Recycling and composting.
  3. Environmentally safe transformation and environmentally safe land disposal, at the discretion of the city or county.
- b. Maximize the use of all feasible source reduction, recycling, and composting options in order to reduce the amount of solid waste that must be disposed of by transformation and land disposal ....

The production of MDO does protect and preserve our public health and safety, our resources, and our environment. It is “recovery” of resources along their highest and best use under Strategic Directive 1, and it is “recycling” under Section 40051. Thus, a directive or premise that MDO production does not

effectively meet these goals is incorrect and, in fact, does not meet CIWMB's Strategic Directives or comply with Section 40051.

**Author's Response:** *We agree that MDO is consistent with CIWMB's Strategic Directives. Although our task was specifically to recommend improvements to optimize the production of re-refined base lube oil, we have gone outside of our specific tasking to recommend a two-tiered incentive system in order to acknowledge the significant environmental advantage of industrial lube oil and MDO production over RFO. Based on the assessment of re-refined lube oil as the "highest and best use," we cannot suggest that they have equivalent incentives if we are tasked with optimization of the production of the product that is the "highest and best use."*

**Comment 10: The Final Report must recommend keeping used oil's designation as a hazardous waste.**

Peppered throughout the February 2008 report, and during the April 8, 2008, meeting, you suggested that used oil's designation as a hazardous waste is a barrier to recycling. As we explained in our prior letter, dated February 15, 2008, and as nearly every attendee who spoke at the April 8 meeting stated, the answer is "no." To the contrary, used oil's hazardous waste designation improves recycling by ensuring that used oil is properly collected, transported, and handled. Without such designation, it will be harder to collect used oil (more do-it-yourself people and small shops will improperly dispose of used oil), to track used oil (transporters will have far less incentive to account for the source, destination, and quality of their product), and to ensure that it is recycled into useful products. Even if removing used oil's hazardous waste designation would make California refineries more competitive with out-of-state refineries, doing so would be a step backward for California, which has the strictest environmental controls in the nation. Those controls have helped to ensure that used oil is not handled or disposed of in ways that pollute the environment.

At the April 8, 2008, meeting, one attendee suggested regulating used oil as a universal waste instead of as a hazardous waste. In the attendee's view, this change would continue to subject used oil to hazardous waste regulation, while reducing certain strict tracking and handling rules. This change, however, would be potentially disastrous.

First, unlike under California's universal waste requirements, used oil transporters are required to register with the California Department of Toxic Substances Control ("DTSC"), obtain an identification number from the U.S. Environmental Protection Agency, and record their shipments on detailed manifests. This tracking not only provides DTSC, CIWMB, and the used oil industry with more detailed information (which will be critical in structuring and evaluating any changes in the recycling market), it ensures through oversight that used oil is properly handled. Without detailed manifests, there will be less information and less accountability. Perhaps even more important, registered haulers are required to maintain more than \$1 million in insurance for accidents; universal waste haulers have no such requirements.

Second, unlike those who handle universal waste, generators and transporters of hazardous waste must file periodic reports with DTSC. This requirement also improves the quantity and quality of information and enhances accountability.

Third, the storage of hazardous waste is more stringently regulated than the storage of universal waste. Storage of liquid hazardous wastes is required in DTSC-permitted tanks that are periodically certified, and these tanks must be situated within a permitted secondary containment system. The tank and secondary containment must be inspected visually at least once a day to look for evidence of a release or

wear to the tank or containment. See generally 22 C.C.R. §§ 66264, 66270. Storage of universal wastes, on the other hand, simply falls under a general regulatory requirement to manage the waste in a manner that prevents any release to the environment. Handlers are not required to obtain DTSC permits. Indeed, because universal waste in California does not currently include liquid wastes, there are not even standards for tank storage of liquid wastes.

Without these controls, a change to a universal waste classification would encourage fly-by-night haulers, provide less information about and control over where used oil goes and how it is recycled, and lead to more improper handling, storage, and disposal of a precious--and potentially hazardous--natural resource. Used oil's current hazardous waste designation provides the appropriate level of control and oversight.

**Author's Response:** *We received strong feedback from stakeholders that the hazardous waste designation benefits for environmental protection exceed the associated costs and handling restrictions. We recognize the importance of maintaining California's leadership in environmental responsibility and stewardship. No change is recommended.*

### **Comment 11: Re-refining Capacity Limitation**

As we have said repeatedly, California's "only current re-refiner" (Evergreen Oil) is not limited by the availability of used oil. While the collection of used oil can and should be increased, the crucial limiting factor is re-refining capacity. The two-tiered, phased-in incentive system discussed above would go a long way toward easing this fundamental constraint.

**Author's Response:** *Given the potential for capacity limitations, we view out-of-state facilities as potential important partners in enabling the maximum amount of used oil to be closed-loop recycled to its "highest and best use." We strongly believe that out-of-state facilities that want to receive an incentive from California for recycling used oil collected in California need to match California standards for used oil, handling, testing, and disposal. This stipulation ensures more level market conditions and prevents the exporting of pollution.*

*Requiring testing of shipments prior to leaving the state places a financial burden on independent haulers that further degrades their market position and ability to get a competitive price for the oil being hauled. The advantage of testing shipments prior to leaving the state is not clear if the out-of-state facility receiving the shipment follows the same testing, handling, and disposal procedures as California facilities.*

*Although our task was specifically to recommend improvements to optimize the production of re-refined base lube oil, we have gone outside of our specific tasking to recommend a two-tiered incentive system in order to acknowledge the significant environmental advantage of industrial lube oil and MDO production over RFO.*

### **Comment 12: Recycling Process Categories**

The Final Report should recognize the value of re-refining and of MDO production, and completely eliminate the use of the word "downcycling" in reference to MDO. More specifically, the Final Report should establish four categories of processes that deal with used oil:

- Re-refining (lube oil production)
- Distillation (MDO production)

- Ordinary recycling without distillation (Fuel Oil Cutter production)
- No recycling (used oil is shipped out of state)

**Author's Response:** MDO has been acknowledged as having the equivalent environmental impact to re-refined lube oil when considering contaminant emissions alone. In our evaluation of the "highest and best use" of recycled oil, products were evaluated on environmental impact in terms of amount of contaminant released, but also on the sustainability of the recycling process in terms of closed-loop vs. single-use recycling (as defined in the report) and if the process is downcycling--resulting in a product with a value/quality below the original material. On page 4 of the main text, we explicitly define downcycling as a "[p]rocess where the quality of the recycled product is less than the quality of the original material." It is not a pejorative term or incorrect when applied using this definition, but reflects the fact that the MDO product has reduced quality compared to the original material. Based on all these criteria, recycling to base lube oil was evaluated as the "highest and best use."

Although our task was specifically to recommend improvements to optimize the production of re-refined base lube oil, we have gone outside of our specific tasking to recommend a two-tiered incentive system in order to acknowledge the significant value of industrial lube oil and MDO production over RFO. The categories you suggest do not fully capture all the important criteria used in our assessment of the various recycled products.

### **Comment 13: Energy and Resource Conservation**

It is not true that re-refined base lube is energy and resource conservative compared with virgin product, unless there is a mandatory minimum content or similar requirement. As discussed above, lube oil is a component of virgin crude oils processed in California, and it takes less energy to remove that component than it does to re-refine used oil into lube oil.

**Author's Response:** In Chapter 7 of its "Used Oil Re-refining Study to Address Energy Policy Act of 2005 section 1838," DOE summarized several previous research efforts into the benefits of re-refining. The analysis of this body of earlier research "supports re-refining as the best solution from both energy resource preservation and environmental conservation perspectives." The American Petroleum Institute states that it takes 50-85 percent less energy to produce a lubricant through re-refining used oil than to produce that same volume by refining virgin crude.

### **Comment 14: Mixing and Sorting**

There is no evidence that mixing automotive and industrial oils reduces the value of used oil for re-refining or MDO production. Indeed, it does not impact D/K's production of MDO.

Sorting is not only unnecessary, it would stymie used oil recycling by increasing its costs. Sorting would require above-ground storage tanks, which require local jurisdiction permits that are extremely difficult and expensive to obtain.

**Author's Response:** Mixing automotive and industrial oil should not impact MDO production, as the fuel oil burns equivalently with either source of used oil. Mixing automotive and industrial oil has the potential to impact re-refining to API-certified lube oil, depending on the ratio of the blend and the quality of the used industrial oil. Thus, sorting is not necessary for MDO production, but may be necessary to maximize the used oil collected for re-refining to API-certified lube oil.

### **Comment 15: Separating MDO and FOC numbers**

It would be helpful to separate MDO and Fuel Oil Cutter stock production in the “fuel oils” figure (41.4 percent).

***Author’s Response:** The data come from the quarterly reporting forms submitted by each recycling facility certified in California. No distinction is made between RFO and MDO on the reporting and so it is impossible to report official volume estimates of these individual products.*

### **Comment 16: CCC incentive**

The current 16-cent/gallon incentive system may not be effective in encouraging do-it-yourself participation (the Final Report should provide recommendations to improve this aspect of the used oil recycling market), but it is vitally important because it keeps certified collection centers in the system. This incentive must not be shifted away or otherwise removed.

***Author’s Response:** We received strong feedback for allowing CCCs to keep their current incentive and recognize the importance of their role in the used oil system.*

### **Comment 17: Certification System**

Under the current system, there is no way to determine whether used oil that is collected is actually recycled. There should be a certification system to ensure that used oil that is collected is, in fact, recycled, and the Final Report should affirmatively recommend this. As noted elsewhere, fuel oil cutter stock should not be eligible for the recycling incentive.

***Author’s Response:** The current testing and reporting requirements are discussed in the main text. It is unclear what certification process would be more thorough than the current reporting system and what facilities the system would certify.*

### **Comment 18: Two-tier Incentive System**

LLNL should recommend, and CIWMB should adopt, a phased-in two-tier incentive system to promote higher quality used oil recycling. Similar to the proposal in AB 1195, re-refining could be given a higher incentive than MDO. Without a phased-in approach, such an incentive would create a special interest incentive for Evergreen as the only available re-refiner. A phased-in approach would incentivize additional capacity.

As part of this two-tier system, “highest and best” use should refer to distilled products, which would include lube oil and MDO. MDO (and its production) must be recognized as valuable and also deserving of incentives.

***Author’s Response:** Although our task was specifically to recommend improvements to optimize the production of re-refined base lube oil, we have gone outside of our specific tasking to recommend a two-tiered incentive system in order to acknowledge the significant environmental advantage of industrial lube oil and MDO production over RFO. Based on the assessment of re-refined lube oil as the “highest and best use,” we recommend a lower incentive for industrial lube oil and MDO.*

### **Comment 19: Haulers Should Meet California's Environmental Standards**

Haulers and out-of-state refineries must be required to obey California's strict environmental standards, including through testing for PCBs, heavy metals, total halogens, and flashpoint. This will establish a level playing field for all who choose to deal in used oil coming from California.

***Author's Response:** Given the potential for capacity limitations, we view out-of-state facilities as potential important partners in enabling the maximum amount of used oil to be closed-loop recycled to its "highest and best use." We strongly believe that out-of-state facilities that want to receive an incentive from California for recycling used oil collected in California need to match California standards for used oil handling, testing, and disposal. This stipulation ensures more level market conditions and prevents the exporting of pollution.*

*Requiring testing of shipments prior to leaving the state places a financial burden on independent haulers that further degrades their market position and ability to get a competitive price for the oil being hauled. The advantage of testing shipments prior to leaving the state is not clear if the out-of-state facility receiving the shipment follows the same testing, handling, and disposal procedures as California facilities. We do acknowledge that testing out-of-state shipments prior to leaving the state, if those shipments would be delivered to a facility that does not follow the same testing, handling, and disposal procedures as California facilities, would assure used oil with contaminant levels that exceed acceptable levels for recycling in California are not being recycled out of state, and thus would assure that California is not exporting pollution related to used oil.*

### **Comment 20: Hazardous Waste Designation**

California's hazardous waste designation for used oil must be retained. Removing this designation would provide less control for the regulated community, undermine California's environmental leadership, and do absolutely nothing to improve used oil recycling in California.

***Author's Response:** We received strong feedback from stakeholders that the hazardous waste designation benefits for environmental protection exceed the associated costs and handling restrictions. We recognize the importance of maintaining California's leadership in environmental responsibility and stewardship. No change is recommended.*

W L Briggs

President, Oil Re-Refining Company

April 30, 2008

### **Comment 1: Used Oil Market Openness**

There are limited processors in California, not because of the lack of used oil, but because these three processors have been able to control the collection, processing and marketing of used oil in California for a number of years, supported by legislation that has protected them from competition. One must marvel at their skill in lobbying for protective laws and use of very capable legal counsel. It is not hard to see how this kind of heavy-handed control can be afforded when these three companies are being benefited by \$60 million a year of funds that would go to the many generators of used oil if they were operating in most of the other states.

The present rules make it very difficult to bring used oil out of California without going through one of the three processors. Hurdles such as predatory pricing, legal challenges to permits for transfer stations, or processors, and other high costs of entry are raised from these three established processors. This also inhibits the growth of re-refining.

This has held back development of more re-refineries both within California and neighboring states because the required used oil volume necessary to justify the investment is controlled by the three California processors. There is a used oil market of more than 124 million gallons per year, which is influenced by these three companies.

***Author's Response:** Given the potential for capacity limitations, we view out-of-state facilities as potentially important partners in enabling the maximum amount of used oil to be closed-loop recycled to its "highest and best use." We strongly believe that out-of-state facilities that want to receive an incentive from California for recycling used oil collected in California need to match California standards for used oil, handling, testing, and disposal. This stipulation ensures more level market conditions and prevents the exporting of pollution.*

*Requiring testing of shipments prior to leaving the state places a financial burden on independent haulers that further degrades their market position and ability to get a competitive price for the oil being hauled. The advantage of testing shipments prior to leaving the state is not clear if the out-of-state facility receiving the shipment follows the same testing, handling, and disposal procedures as California facilities. We do acknowledge that testing out-of-state shipments prior to leaving the state, if those shipments would be delivered to a facility that does not follow the same testing, handling, and disposal procedures as California facilities, would ensure used oil with contaminant levels that exceed acceptable levels for recycling in California are not being recycled out of state, and thus would ensure that California is not exporting pollution related to used oil.*

## **Comment 2: Payment for Used Oil**

One only has to turn to most of the other 49 states that follow the Federal Used Oil Rules to find used oil generators being paid \$.35 to \$.75 per gallon for their oil by collectors who generally sell it for fuel.

*Author's Response: Thank you for the additional detail on specific pricing of used oil in other states.*

## **Comment 3: Used Oil Products/Producers**

California used oil appears to be processed as follows:

### **True Re-Refiners**

#### In-state:

1. Evergreen Environmental--Only true re-refiner in California, which processes 15 million to 18 million gallons per year. They also ship additional volume out of state to be used as fuel.

#### Out of State:

2. Safety-Kleen purchases 13 million gallons per year of used oil from D/K (one of the three California processors). It is shipped to the Chicago Illinois re-refinery.
3. An additional 5 million to 7 million gallons is shipped to new re-refineries in Nevada and Oregon. These facilities are the newest re-refineries to be constructed and can easily handle 20 million gallons per year.

As it stands today, less than 38 million gallons of California's 124 million gallons of used oil is being re-refined. This is a huge loss as re-refining is the true path to oil sustainability because it is the only process that allows oil to be used over and over again.

### **Fuel Oil Refinery**

D/K – Located in Southern California, it appears to be processing perhaps 60 million gallons of used oil per year. Based on outside information, about 70 percent of that used oil is processed by vacuum distillation into a marine-type diesel fuel, asphalt flux, and lite petroleum distillates. They also ship minimally recycled fuel (RFO) out of state.

### **Industrial Black Fuel Oil**

Next is Industrial Oil Services in Southern California which processes perhaps 30 million gallons of Refined Fuel Oil. Refined fuel oil is a black low-grade industrial fuel oil that is simply dewatered and filtered to be sold outside of California. This low-grade oil is shipped by all three California processors via railway and ocean barges to be used as fuel in burners such as electric power plants, large industrial boilers, and asphalt paving hot plants in other countries or other states where it is permitted to be burned.

*Author's Response: We have identified the producers and explained the same products in the main text. We appreciate the additional detail about the products/producers included in your comment.*

#### **Comment 4: Emphasis on Sustainable Used Oil Recycling**

All three of the California processors ship this low-grade fuel, which could also be the crude oil stock to feed re-refineries, while burning ends the useful life of this very valuable resource forever. If we re-refine, instead of burning this used oil, we can make oil a true sustainable resource as oil can be re-refined repeatedly into lubrication oil and other base stock. With the price of oil at record highs, it seems a travesty to be burning something that can be re-used over and over again. Also, when you consider that just 1 percent of all the billions of gallons of crude oil is lubrication oil, you must realize that we need to conserve and re-fine oil to its fullest extent. We need it all!

***Author's Response:** In our evaluation of the "highest and best use" of recycled oil, products were evaluated on environmental impact in terms of amount of contaminant released, but also on the sustainability of the recycling process in terms of closed-loop vs. single-use recycling (as defined in the report) and if the process is downcycling--resulting in a product with a value/quality below the original material. Based on all these criteria, recycling to base lube oil was evaluated as the "highest and best use".*

#### **Comment 5: No Rule Changes**

The simple solution to California re-refining problems is to allow the current rules to remain as they are. The three California processors are finding that other states are helping, allowing the used oil to begin to move outside toward true re-refiners such as Safety Kleen, Encore Energy, and Consolidated Recyclers, as well as new re-refineries being constructed at this moment. If the three California processors, who seem to find it more profitable to ship the black used oil out of state, would have made the new investment into needed re-refining they would have solved the problem long ago.

***Author's Response:** We acknowledge that the market appears to be functioning effectively and our stakeholder feedback affirms that view. For these reasons, our recommendations are market-based solutions in order to move the market in the direction of CIWMB goals and are extremely limited in mandates or additional regulations.*

#### **Comment 6: Incentive on Recycled Lube Oil Product**

If California wants to further accelerate the re-refining process, a simple solution would be to take the \$.16 per gallon new lubrication oil rebate and use it to fund an incentive for re-refineries both in-state and out-of-state who purchase used oil from the California market. It should include the stipulation that at least 60 percent of that oil be re-refined into lubrication oil with the remainder being allowed for use as asphalt flux or fuel. All re-refiners would be required to pay for a private or state-appointed auditor to confirm the required ratio and volume in order to receive the \$.16 per gallon rebate.

One of the only concerns about this incentive program would be assuring that the generator of the used oil receive the rebate which would be due to them at the time of collection. If the used oil is going to be used for fuel there would be no payment or credit at the time of collection. The collector, in turn, only gets its \$.16 per gallon reimbursed when and if the product is sold to the re-refiners. This would promote used oil recycling and sustainability at all levels.

***Author's Response:** We recommend a monetary incentive, based on the volume of API-certified base lube oil produced from used oil collected in California, to recycling facilities producing API-certified base*

*lube oil both within and outside California that maintain California standards for used oil handling, waste classification and disposal.*

*We received strong feedback for allowing CCC to keep their current incentive and recognize the importance of their role in the used oil system. We also recommend a two-tiered incentive system in order to acknowledge the significant environmental advantage of industrial lube oil and MDO production over RFO.*

*We strongly believe out-of-state facilities that want to receive an incentive from California for recycling used oil collected in California need to match California standards for used oil, handling, testing, and disposal.*

#### **Comment 7: Additional Info**

Should you like more input from a stakeholder who operated in a number of states, is part of the National Oil Recyclers Association, is part owner of two re-refineries, as well as four black oil processors, and with 30 years of experience in the used oil recovery business, please let me know and I will make myself available. Thank you for helping to solve this problem.

***Author's Response:*** *Your stakeholder feedback to date and these comments have been very helpful. We will continue to involve you in any additional discussions.*

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